# GRAPHIC SCIENCE

*Taking the Guesswork out of Drawings*

*APRIL 1961*

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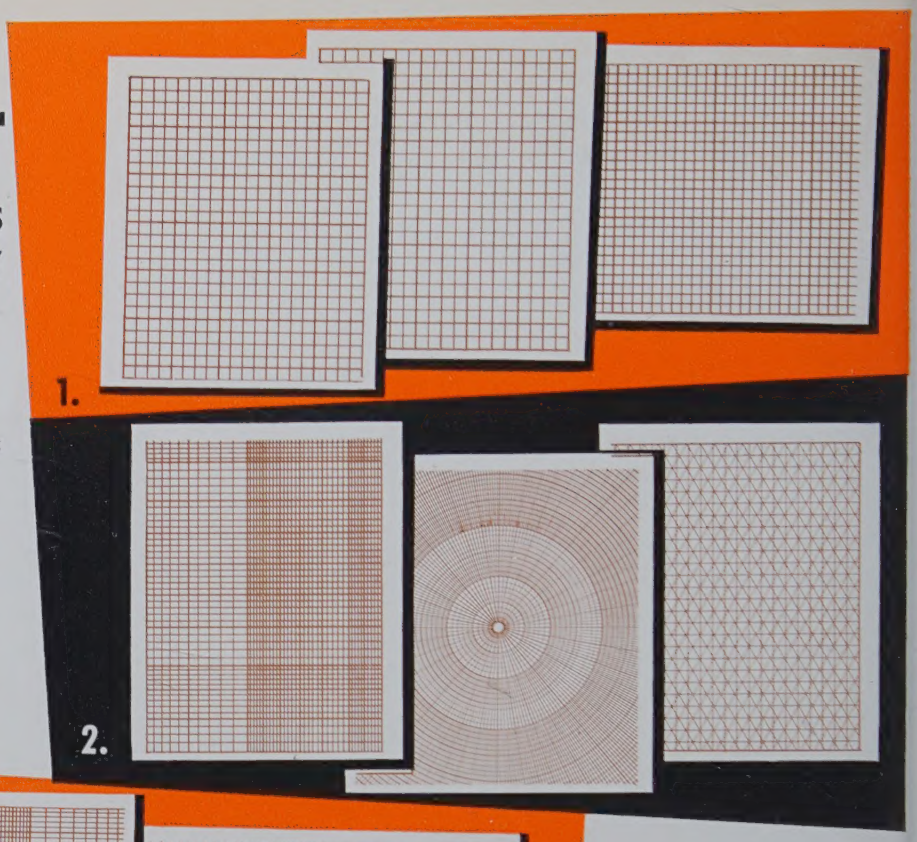


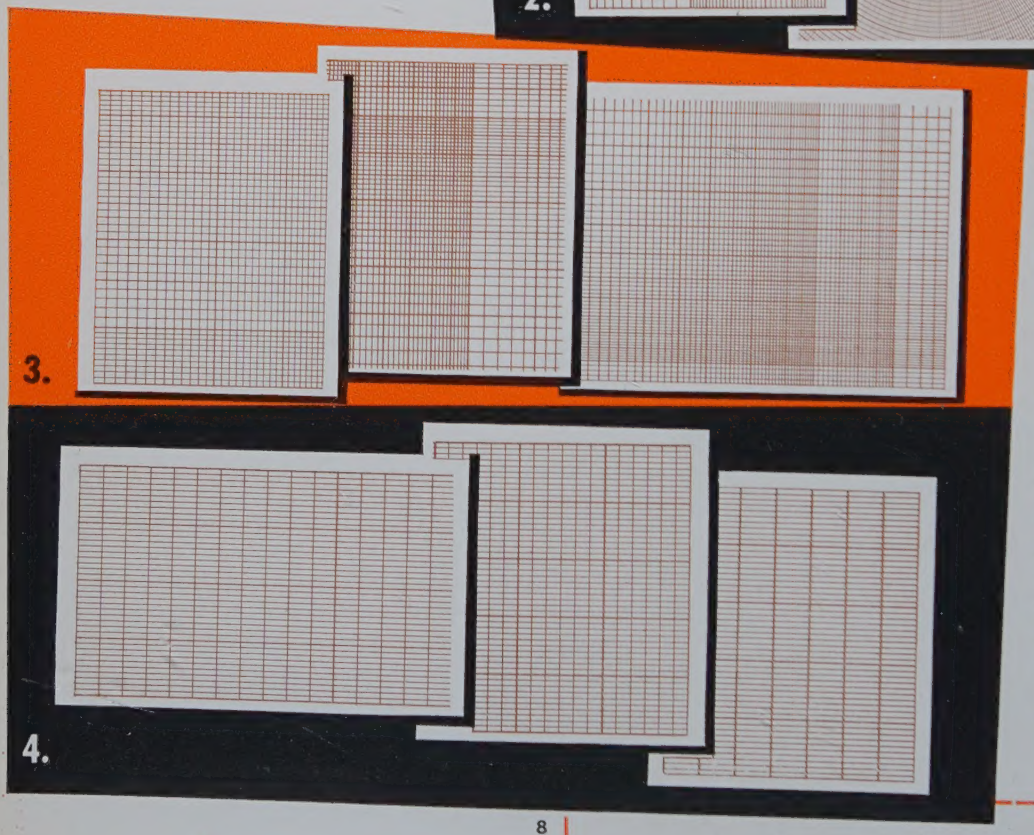


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# GRAPHIC SCIENCE

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*APRIL 1961*

VOLUME 3 NUMBER 4

The Magazine Serving Engineering Drawing Management—covering drafting, reproduction and microfilming, technical illustration, drawing standards and engineering documentation.

ARTICLES



## *Next Month*

SPECIAL ISSUE ON EDUCATION

THE FUTURE OF ENGINEERING GRAPHICS

*Comments from several academic leaders on the role engineering graphics will play in the education of future engineers*

DRAFTSMEN ARE MADE—NOT BORN

*The Chief Draftsman and the Supervisor of Drafting Training at Chevrolet Motors Div. of General Motors Corp. discuss their company training program*

DEPARTMENTS





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# Letters

**Our Apologies**

Sirs:

I read with much pleasure your GRAPHIC SCIENCE Magazine.

In the January 1961 issue, page 23, you have a heading "Automatic" lead pencil. "Automatic" is one of our oldest trade marks for lead pencils, which was first used by us in 1879, and originally registered in the United States Patent Office on February 14, 1882, under No. 9,102, and presently registered under No. 70,598, September 15, 1908, and duly renewed in 1928 and again in 1948, and is in full force and effect.

"Automatic" for a lead pencil is an arbitrary term to which our exclusive rights have been consistently recognized by the pencil industry from the outset.

The descriptive term for the pencils you designate as "Automatic" pencils, is "Mechanical" pencils.

We have been vigilant over the many decades in calling to the attention of publishers of directories and the like any inadvertence, such as yours, in using the term "Automatic" instead of the really descriptive term "Mechanical" in designating pencils of the type to which your heading was directed.

Such publications and directories have cheerfully cooperated with us in using thereafter, when notified by us, the correctly descriptive term "Mechanical."

I know that you will cooperate with us in the same spirit as did the others, and will write us to that effect.

ALFRED C. BEROL

President
Eagle Pencil Co.
Danbury, Conn.

**Disageement**

Sirs:

I should like to comment on Irwin Wladaver's letter which appeared in your December, 1960 issue. Up to a point, I will agree completely with my friend, Wladaver. However, his last sentence should illustrate the fact that while there is practically complete unanimity of purpose within the Division of Engineering Graphics (that of keeping graphics in engineering curricula), there is also considerable disagreement as to how this objective can best be attained.

Any engineer who is worth his salt knows that there are many solutions to any particular problem and several methods which can be used to obtain one specific solution. Furthermore, he knows that the problem must be defined before a solution can be attempted.

In the particular case in question, I feel that the problem has only partially been defined. We realize that part of the problem is that of keeping graphics as a part of engineering curricula, and that some of the people who must be convinced of this are deans of engineering and heads of degree-granting departments. However, are even the members of the Engineering Graphics Division in complete agreement as to the meaning or implications of the term "graphics"? I'm afraid not.

Until we are convinced ourselves that the engineer must be able to use interchangeably written, mathematical, and graphical forms of expression or that graphical solutions are as valid (and in some cases, more effective) than numerical ones, we are certainly not going to convince others that graphics is just as fundamental to an engineer's training as are English, mathematics, etc. And until we have such convictions throughout the entire membership of the Division, the net result of any efforts (including surveys, name changes, etc.) will, predictably, continue to be zero.

ROBERT D. LARUE

Associate Professor and
Circulation Manager & Treasurer
Journal of Engineering Graphics

P.S.—It should be noted that this letter was prepared before the recent mid-winter meeting of the Graphics Division and that some of the ideas expressed herein were presented by other individuals at the meeting.

Sirs:

I have no basic disagreement with my good friend, Professor LaRue. It may be true that not all members of the Division of Engineering Graphics of the American Society for Engineering Education have the same attitudes towards graphics nor, for that matter, the same degree of competence and scholarship. Naturally the thinking about the place of graphics in education and in the daily profession of engineering must differ in detail.

And surely the deans of engineering, the degree-granting department chairmen, and the curriculum makers are the people who must be convinced that graphics is an engineering science that belongs in every engineer's tool kit. How many of these important people believe this? Certainly they are honest men whose prime interest is educating engineers and the emerging, new curriculums reflect their best thinking. It must be obvious that the deans and the department chairmen have not been convinced that graphics deserves a paramount position in colleges of engineering.

Clearly surveys and other devices we have tried have utterly failed to bring about any favorable changes in any engineering curriculum with respect to graphics.

My question, then, to Professor LaRue and to anyone else who is deeply concerned about the problem, no matter what the definition of the problem may be, is this: What positive steps are likely to improve or even protect the deteriorating position of graphics in engineering education?

IRWIN WLADAVER

Chairman
Division of Engineering Graphics
Amer. Soc. for Engineering Education

*Letters to the editor should be addressed to* GRAPHIC SCIENCE, Wilton, Connecticut. *Names will be withheld upon request but all must be signed.*

# *Notes & Comment*

## *New Associate Editor*

GRAPHIC SCIENCE is happy to announce the addition to its roster of Associate Editors of the name of George E. Rowbotham, author of this month's feature article, "Taking the Guesswork Out of Drawings." Mr. Rowbotham is Standards Supervisor of the Greenwich Engineering Division of American Machine & Foundry Co. Over the past twenty years he has accumulated such varied experience as drafting, engineering, standardization, and administration. He has held positions as chief draftsman, engineering manager, standards engineer, checker, and draftsman with organizations such as General Motors Corp., Ford Motor Co., Chandler-Evans, Curtiss-Wright, and Hartford Special Machinery Co.

Currently, Mr. Rowbotham is a member of the SAE Aero-Space Drafting Committee G-1, ASA Y14 Sub-Committee 5, and the AOA Engineering Documentation Section Sub-Section on MIL-STD-8. He is a member of the American Society of Mechanical Engineers, Society of Automotive Engineers, and American Ordnance Association.

His pet project, to which he has devoted over a decade of active interest, is the establishment of national drafting standards.

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## *Where you can obtain . . .*

### Government Specifications, Federal Standards, Drawings, and the Indexes which list these specifications

FEDERAL SPECIFICATIONS are available from the General Services Administration Regional Offices. Federal Specifications and Federal Standards are for sale *only* by the Regional Office 3, Washington 25, D.C. However, a *single copy* of any current Federal Specification or Federal Standard may be obtained without charge for bidding purposes providing the Invitation for Bid Number is furnished.

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**Army**—Army supply installations throughout the United States.

**Navy**—Requests should be directd to: Commanding Officer, U.S. Naval Aviation Supply Depot, 700 Robbins Avenue, Philadelphia 11, Pennsylvania.

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**From the Superintendent of Documents, Government Printing Office, Washington 25, D.C., you can obtain only the *Indexes*** of Specifications and Standards. These are listed below.

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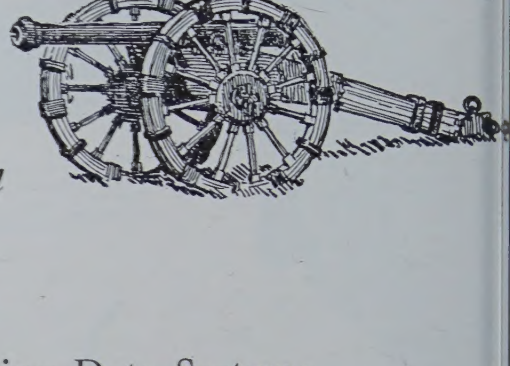

# *Military Engineering Documentation*

by W. S. Hutchinson

## Microfilm's Place in DoD Engineering Data Systems

JUST A YEAR AGO the DoD announced approval of a series of military specifications and standards for microfilming engineering data. Their development in less than two years marked an extraordinary achievement. Industry made this possible. The DoD is presently embarking on a comprehensive series of studies that will disclose, for the first time on such a broad scale, the full extent of military requirements for engineering data systems. These studies will do more than that. They will appraise deficiencies which cause delays and excessive costs.

By creating the EDMS, the DoD has made possible not only a multitude of savings thru speedier reproduction with miniaturized data handling and storage, but also a common medium which now exists for interchange purposes. This common language approach holds vital importance for inter-weapon system's management. Without the practical ability to transfer engineering data freely among the services, such data would remain compartmented, requiring conversion to suit each separate user's requirements. Standard microfilming procedures and standard PCAM tab and aperture cards have unified the military services under a single system whereby engineering data can be acquired, processed, and exchanged with the assurance that it is always readily usable.

But the job isn't finished; it has really just begun. I am referring to the whole task of evolving a completely integrated DoD-wide system for managing engineering documentation.

Several factors make it imperative that the broad area of engineering documentation be accorded importance second only to the hardware itself. Engineering data is a basic commodity, absolutely essential to the national defense mission. Numerous surveys have revealed serious problems awaiting solutions. They have revealed areas where data costs too much, unnecessary data is purchased, not enough or the wrong data is available, data is incorrect or out-of-date, format differences prohibit automated processing, rapid retrieval capabilities are missing, etc.

All past surveys have been piecemeal, or fragmented, never attacking the problem as a whole. A DoD overall view has been missing. Hence, it has been difficult to get an accurate picture of the magnitude of the gross problem, and to evaluate the total impact on the entire military establishment. Some solutions were jury-rigged, so to speak, to answer the needs of a functional segment of operations, as missile systems, for example. None took in the whole gamut of engineering data administration to achieve across-the-board compatibility. None, that is, except those established under the policy of coordinated DoD documents, notably standards and specifications, such as for drawing practices.

We are faced today with an array of engineering data requirements which vary widely from service to service. This untenable position is a normal historical sequence arising from parallel developments throughout the huge military organization. To pull it together into an integrated system for engineering documentation is truly a tremendous undertaking. But this is what the Standardization Division of the AFSSC has set out to do.

EDMS has established a precedent proving that the Armed Forces can find a workable solution to a complex problem, and still meet the individual needs of each activity. Now the task ahead must deal with other processes for handling data, including the basic formats the data appears in. It is important that the EDMS be meshed in properly with these processes and formats.

We have enlisted the assistance of industry to render expert advice to the DoD in determining a wise course. A Defense Drawing Practice Industry Advisory Committee, chartered under DoD Instruction No. 5126.21, will deliberate every step of the way as we proceed to assess requirements, then seek the best solutions. The membership of this committee is composed of engineering and management personnel experienced with all facets of engineering documentation. Both military and industrial users are represented, as well as manufacturers and universities. Talents range from data preparation to the various mechanized techniques for processing, retrieving, and storing data. We believe that the quality of decisions reached will

*See page 6 of this issue for information on where to obtain copies of Government Specifications, Federal Standards, Drawings, and the indexes which list these specifications.*

be improved if problem-related information and ideas are exchanged on a joint basis with our industrial counterparts. Our purpose is to bring to the decision-making process a high degree of reliability, thus assuring sound administration.

During the past year the military departments have begun gearing in earnest for systemization of engineering data. The Air Force has established Engineering Data Service Centers at prime AMA's under the policy set forth in AFR 67-28. Headquarters AMC centrally administers the AF program known as MEDAL, meaning Micro-Mechanized Engineering Data for Automated Logistics. Contractual requirements are spelled out for all Air Force-procured engineering data in MCP 71-77, entitled "Engineering Data Requirements for Materiel & Services (USAF)." This contractual document, incidentally, invokes the microfilming specifications and stanmicrofilming specifications and standards developed for the EDMS.

The Navy in December 1960 issued SECNAVINST 4120.12, covering the "Establishment of Requirements for Engineering Drawings, Associated Lists, and Additional Data." This instruction applies to research, engineering, technical requirements, supply, maintenance, quality assurance (including inspection), procurement, and all other functions of the Department of the Navy directly or indirectly concerned with data processed from contractors or prepared within the Navy, and the control and use of such data.

It is worth while to examine the objectives of the Navy instruction as it establishes a practical means of minimizing the kinds and quantities of data to be procured. Careful selection of the type and quantity of data necessary for intended uses by functional application is made with the aid of a Data Check List (*to be published in this section next month*).

In selecting the one or more intended uses for data, consideration is to be given to the immediately planned and future probable use of the weapons system, equipment, or other item to which the data relates. To the extent it is pertinent, due regard should also be given to those circumstances which led to generating the requirement for the item. Some of the specific factors which may be pertinent to the selection of intended uses are:



(a) The item is for a special fleet or shore installation with no more than limited reprocurement envisioned;

(b) The item is for a single installation with no reprocurement envisioned;

(c) The item is a one-of-a-kind type, such as a breadboard or experimental model, with no planned development or production;

(d) The item is one that could progress from the breadboard experimental stages, through the developmental prototype stages, on to final production;

(e) Reprocurement of the item, under circumstances consistent with the over-all policy of procurement with competition set forth in ASPR 1-300 and the applications of that policy to the procurement parts set forth in ASPR 1-313, cannot successfully be accomplished except from the original manufacturer;

(f) Reprocurement of follow-on quantities of the item will involve multiple-source procurement and competition, but will be accomplished through the medium of a performance specification where initially obtained drawings and additional data are not adaptable for reprocurement purposes;

(g) Reprocurement of follow-on quantities of the item will involve multiple-source procurement and competition, and initially obtained drawings and additional data, whether or not supplemented by performance specifications, will be used to specify the requirement; and

(h) Item separation from an assembly or equipment is required to facilitate a broader procurement base for prime contracts or subcontracts.

The instruction provides that each bureau and office, and each major field activity designated by a bureau or office, shall establish a Data Review Board. This board shall be responsible for reviewing and approving the data requirements for each engineering system, equipment, or other item having an estimated value in excess of $1,000,000 that is contained in a procurement request or the specification applicable thereto. Members of the board shall be appointed to represent requirements, legal, contracting, engineering, provisioning, and small business functions.

(*To be Continued Next Month*)


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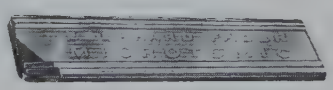

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# Types of Technical Drawings

by Franz Maria Feldhaus

This is a continuation of Chapter III of an authoritative and beautiful book, **THE HISTORY OF TECHNICAL DRAWING,** by Franz Maria Feldhaus published in 1959 by Franz Kuhlman, K.G., of Wilhelmshaven, Germany, as **GESCHICHTE DES TECHNISCHEN ZEICHNENS.** We are indebted to the publisher for the translation, as well as for permission to republish this fascinating work. It will be continued in this department from month to month, until completed.—The Editors.

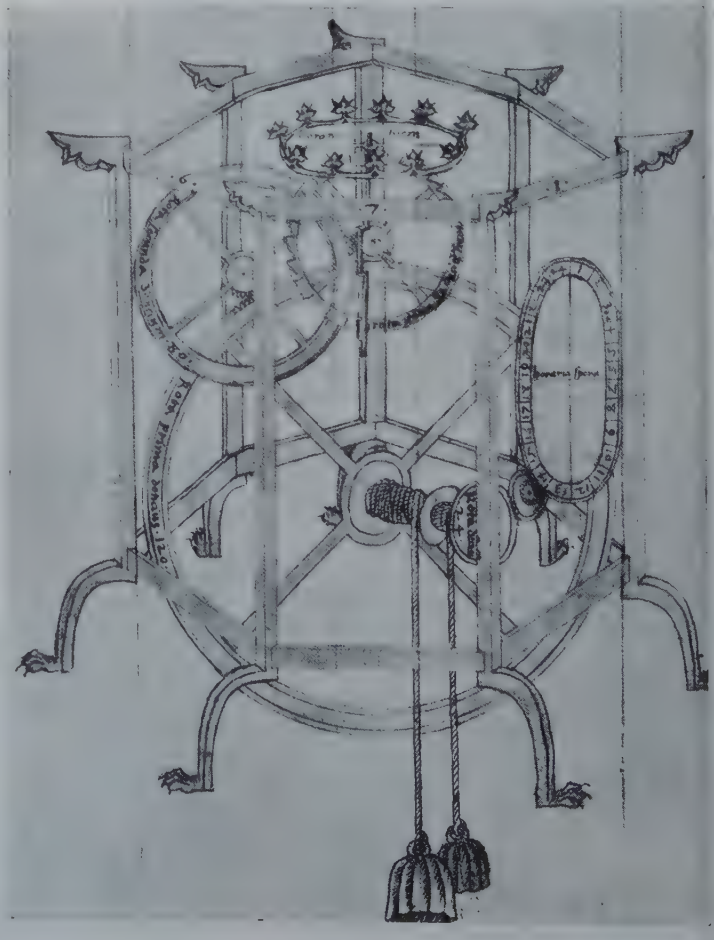
DRAWINGS of machines from the Middle Ages are very rare. They were usually preserved only when they had been attached to documents. The illustration here shows such a paper dating from 1348, depicting a large steeple clock which was put into the steeple of the palace in Padua by Dr. Giacomo Dondi about 1350.

The sketchbook of a machine technician who took part in the Hussiten war on Germany's side is today in the state library in Munich. It was possible to date it because the siege of Saaz in September 1421 was mentioned. The author of the booklet does not mention his name. The many pen-and-ink drawings are explained by short texts. One sees lifting gear, a drill for wooden water piping, earth drills, rams and a machine for polishing diamonds. The transmission ropes and the four table legs were drawn rather clumsily.

The most extensive literary remains in our possession are by Leonardo da Vinci, the illegitimate child of a farmer's daughter and a jurist, who became artist, scientist, anatomist, technician and inventor, philosopher and poet. Roughly 10,000 technical sketches and drawings of his have been preserved and it is known that much was lost. Almost all his literary remains are today published in facsimile editions.

Leonardo drew parts of buildings and machines in good perspective, but added careful plan-sketches to show particular details. A large number of sketches were carefully made, others quite carelessly. The explanation for this may be that Leonardo, who spent years in a position at court, had to give explanations to people who were technical laymen, so he sketched things during conversation and did not have to be particularly careful about them. Leonardo was better able than almost any other technician to illustrate a complicated machine clearly. He made many drawings on loose pages, others in booklets, some of which deal with one complete theme. But among machines and architectural illustrations one can also find flowers, animals and landscapes.

Most of his sketches are framed by notes, text outlines, remarks and arrays of figures. After his death the large sheets of drawings were ordered and compiled in an atlas according to size. In that way drawings belonging together were separated and it caused



**TOWER CLOCK**
*(Pen and ink drawing by Giacomo Dondi, Padua, 1348.)*

a great deal of trouble to put them together again in the correct order. If Leonardo had not made technical sketches as well as artistically valuable drawings and notes on art history, it is doubtful that his papers would have been preserved at all. He bequeathed them to a young favored pupil belonging to a rich Mailand family, who kept all these literary remains until he was quite old. It was he who drew attention to their importance.

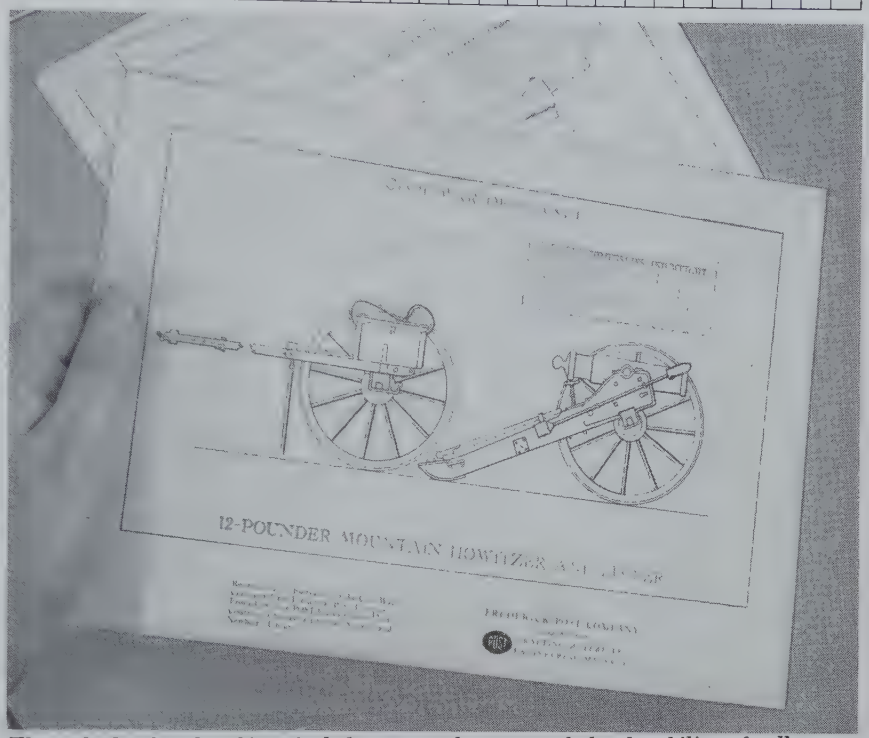
Sketch books of famous inventors and engineers are rare today except for the few that were kept in museums. The literary remains of James Watt are in the Science Museum in London, those from Edison in the museum in Detroit. Some remarkable sketch books are in the archives of the German Museum in Munich.

The largest collection of old technical drawings in existence today are the illustrated manuscripts of technicians from the Middle Ages. It is certain that many valuable pieces have been lost in fires in sieges. A great deal was lost through carelessness because people thought that these drawings, being not always easily understandable, were merely useless curiosities. The few remaining manuscripts of this kind show that they were not merely sketchbooks but fair copies. It was also discovered from copies of famous manuscripts that specific drawings of machines had been transferred to later manuscripts.

Such manuscripts were sold to Regents, and city administrations to acquaint them with technical innovations. Many of these works have long texts; some are even in rhyme! There are also some without any texts at all. These drawings are in many instances difficult to understand. This shows that the engineers as a rank did not feel tied nationally, like the Condottiere, the mercenary leader of troops who offer their services to big and small potentates. They were soon installed when they showed a volume of technical drawings which were mostly colorfully painted. The fewer the written explanations added to the drawings the more likely it was that the engineer would be engaged for a particular job. He sold the manuscript with his service.

*(To be continued)*

# DRAFTING TRENDS

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GRAPHIC SCIENCE

APRIL, 1961

VOLUME 3 NUMBER 4

# TAKING THE GUESSWORK OUT OF DRAWINGS

*How to prepare your own company Standards Practice Manual and do away with the daily difficulties of interpreting drawings and shop-run tolerances*

by George E. Rowbotham

THE PAST DECADE has seen outstanding progress in drafting. The rapid pace of technology, the advancement of highly complex weapons and commercial products, the improvement in manufacturing techniques, the tremendous increase in output of drawings, and the close correlation of the nation's engineering effort have all focused critical attention on drafting standards. This added attention has accelerated the need for improvement. The mandate to improve applied to all areas in drafting where benefits could be achieved.

The basic underlying objective has been to establish a common language and to permit workable interchangeability from multiple sources of supply. The trend is to take the guesswork out of drawings. Current practice is to avoid non-qualitative terms such as, "to be flat," "mirror finish," "holes must be parallel," and the like. Such loose terms offered excessive latitude in interpreting quality requirements. This practice, with its element of guesswork, made it possible to pay excessively high costs for quality that was better than needed. Conversely, high quality was often lacking when needed. Such terms required considerable negotiation. Tolerances of form, essential for interchangeability, have been omitted in the past because there was no uniform method of indicating them. The absence of such engineering documentation permitted the shop to determine tolerances. This was a laborious and irresponsible practice since shop personnel lacked sufficient knowledge to assess tolerances. Interchangeability and performance, under such conditions, became a matter of guesswork instead of sound engineering practice.

Standards to remedy these conditions do not come by accident. They are developed with organized machinery. The various drafting standards committees of the American Standards Association, Society of Automotive Engineers, and the Department of Defense attacked the problem. Out of this combined council came new concepts and the refinement of such old ideas as true position dimensioning, tolerancing for maximum material condition, decimal dimensioning, geometric tolerancing, and uniformity of method in indicating surface qualities. Which goes to prove the wise Solomon was right when he penned the proverb: "In the multitude of council there is wisdom."

## TRUE POSITION DIMENSIONING

A MILESTONE along the path of progress was true position dimensioning which originated in the aircraft industry. Its value was quickly recognized and it spread to the automotive industry. In a short time, true position dimensioning was enthusiastically adopted by both the SAE and ASA. This realistic tolerancing practice denotes the basic exact position, eliminates possible tolerance build-up, and permits manufacturing to exceed limits where anything less than the maximum material condition exists. With this practice there is less chance that usable parts will be scrapped. Decimal dimensioning was originated by Ford Motor Company back in 1932 and its acceptance by others has been rapidly multiplying. It offers the advantages of the metric system long advocated by many, without the disruptive work and expense that would be entailed in such a radical conversion. One of the advantages of decimal dimensioning is the simplification of arithmetical computations. Dimensions are considered only in terms of decimals, obviating the need for cumbersome conversions. Converting the reading of such measuring tools as micrometers, vernier calipers, and height gauges, which are graduated in decimal increments of an inch, becomes unnecessary. It takes the guesswork out of deciding what is half of such unwieldly fractions as 39/64. Decimal dimensioning offers all the merits required for a national standard. Another notable development is the uniform method

accepted for expressing requirements for tolerances of form based on actual working surfaces, rather than imaginary center lines, axes, datum lines, or points.

During the process of developing these drafting innovations, there was consciousness of the need for keeping standards flexible, and the way was left open for further development and change. Improvements and new concepts in drafting are bound to keep pace with changing demands. An urge to improve is a driving force in standardization work. When standards cease to be useful, revised or new ones will most certainly be developed.

### Standards

Recent emphasis on improved drafting will probably revive in some quarters the old fears that drafting standards will stifle human values, make draftsmen obsolete, or even spawn a race of pencil-pushing robots. Some even fear that drafting standards will stifle originality and curtail inventiveness. Such fears are nonsensical. Standards and the people who develop them place a high premium on human intelligence. Standards document solved problems and leave the creative abilities of draftsmen free for more important work. The individual is free of considerable drudgery and able to stretch his thinking power to the limit. Drafting standards will in no way curtail inventiveness, new practices, materials, or processes. If anything, they will hasten the acceptance of the results of research and development. Draftsmen who follow drafting standards actually advance faster. They learn the latest practices and profit from the experience of others. They require less supervision and produce, with considerably less effort, more legible drawings in conformance with industrial or military specifications. Easier checking, fewer mistakes, and less confusion in manufacturing, inspection and procurement are the results. Drafting standards put an end to innumerable difficulties that otherwise would be multiplied and compounded.

Some people are often misled into believing that drafting standards are a form of red tape, limitation, and restrictive regulation. Actually, standards are developed by the same cooperative and democratic process used in this country to establish standards are not handed down by decree ards of law and government. Standand proclamation, but rather are formulated by the voluntary agreement of all groups concerned. They are controls that management employs to direct smooth and efficient operation. The government obviously has the right to set standards for the products it buys. Historically, the government, particularly the Department of Defense, has an admirable record in developing standards, in sharing knowledge, and in profiting from the experience of responsible people in industry. Differences between military and industrial drafting practices are well known and have been the topic of heated discussion. Remarkable progress has already been accomplished in the effort to reconcile military and industrial viewpoints. Discussions are continuing. Both sides have at least one common denominator: they are conscientiously concerned with drafting. There is mutual confidence. They jointly recognize the commercial advantages and probable military expediency of uniformity of practice. Everyone is aware that the solution lies in consensus. Every group substantially concerned—manufacturer, design engineer, the government—should obviously have the right to participate in deciding what the provisions of a drafting standard should be. None should dominate a decision at the expense of another.

Another problem in any standardization effort is the constant threat of fanciful notions. Some wishful thinker's daydream will invariably be hieroglyphics, Roman numerals, short cuts, rough sketches, and various gimmicks. However, contractual requirements alone often preclude the use of any ill-conceived practice. Military and customer specifications require quality drafting. Added emphasis on quality drafting results from the reproduction problems encountered today in micro-photography where the reduction in size of drawing is as much as 30 to 1. Adherence to military, SAE and ASA drafting practices assures good microfilm copy.

There is indisputable evidence that any reasonable effort is warranted which contributes to the preparation of accurate, legible, and complete drawings. Drawings should be prepared with the thought that not all of its readers will be possessed with high powers of visualization and not all readers are trained draftsmen. A reader may attempt to understand in a matter of minutes a drawing that required hundreds of hours to complete. There simply is no longer any place in drafting for any form of guesswork. A drawing which is readily understood provides a high degree of insurance against serious delays and costly errors of misinterpretation in the manufacturing and purchasing of products.

Obviously, drawings should be reduced to their essentials. In the interest of speed and drafting economy, certain conventional representations and symbols which will not impair clarity are acceptable in the delineation of electrical components, welding, gear teeth, screw threads, piping, etc. Certainly, pictorial practices should be avoided and drawings should be free of ornamental detail lacking in intrinsic value, such as shading, fancy lettering, unnecessary projection, and repeated detail. Such artistic frills absorb additional man hours of work, but do not in any measure help take the guesswork out of drawings.

While the general objective in the preparation of a drawing is a complete description of the part with minimum reference, there are many requirements that are repetitious and need not be specified on the drawing. For example, practice is to specify only the material specification number, but not the details of the specification on the drawing. Also, drawings need not be cluttered with excessive tolerance detail. For example, it should not be necessary to specify tolerances for undercuts, thread reliefs, chamfers or drilled holes, nor should it be necessary to specify runout for drilled holes. It is impractical to specify tolerance requirements for concentricity, flatness, parallelism, alignment, straightness, squareness, surface finish, and true position for every surface, hole, thread, and element shown on the drawing. Nor would it be practical to note definition of terminology directly on the drawing. Any drawing that included this avalanche of information would become a cumbersome maze of detail and be extremely difficult to read. The engineering cost would make such a drawing almost prohibitive. It therefore becomes essential to supplement drawings by a document that defines the undimensioned and unnoted areas.

Interpretation of drawings is still an unsettled problem in spite of the discussions that take place every day. Interpretation of drawings is the big unfinished job. Two engineers may agree on method of preparation, but will often disagree on the intent. The problem of interpretation, which obviously is not everybody's art, should not be left to discussion and arbitration. Arguments could go on and on endlessly.

What is needed is a dictionary of terms, a Standards Practice Manual, whose contents would be devoted exclusively to interpretation and shop-run tolerances. Such a standard would at one stroke do away with many of the interpretation difficulties encountered daily by draftsmen, engineers, mechanics, inspectors, machinists, and purchasing agents. Such a standard has been envisioned by drafting administrators for years, and some companies have already done an excellent job in this area. The subject of interpretation is included in some national standards, but coverage is spotty. Unfortunately, no accepted national standard exists that adequately fills the bill. Eventually, a unified national standard will undoubtedly be published. In the meantime, it is deemed wise for individual drafting administrators to prepare their own company standard to cover this important subject.

This enginering document should clearly define engineering intent, establish uniformity of interpretation, and provide shop-run tolerances. The shop-run tolerances included should be those that are economically obtainable under normal production conditions and represent the most frequently occurring requirements of engineering. Such a standard is prepared primarily for shop, inspection, and purchasing personnel. It should be written in a language they will understand and not be weighted down with double talk and long words.

The Standards Practice Manual should answer such questions as whether or not dimensions apply after painting, heat treating, plating, etc. It should define and clarify terms, symbols, and notes. Its definitions should cover such terms as "true position," "straightness," "maximum material condition." It should provide shop-run tolerances for keyways, undercuts, centers for machining, counterbored holes, countersink holes, drilled holes, thread lengths and depths. It should provide surface roughness requirements for splines, ball-bearing lands, gear teeth, reamed holes, "O" ring grooves, etc. Tolerances should be included that are the acceptable standard variation for parallelism, squareness, flatness, concentricity, straightness, and true position, when specific requirements are not noted on the drawing. With such an arrangement, as offered by a Standard Practice Manual, drawing revisions can be held to a minimum. Such a standard maintains a blanket uniform control over a block of drawings. Should it be necessary to change, for example, the surface roughness requirements of "O" ring grooves, it would require only a revision in the standard. It would not require a mass change for all drawings that involve "O" ring grooves, which in some instances, could amount to hundreds of drawings.

## Producing the Manual

The Standards Practice Manual should be comprised of two sections. The first section should include definition and interpretation of terms and symbols. The second section should state the applicable shop-run tolerances that are expected to result from general all-around machine shop practices. The subjects should be arranged in alphabetical sequence for easy reference. There should also be an index with sufficient cross reference to assist in the finding of a particular subject. The writer should not be required to dig out the facts, nor should he be burdened with unnecessary reading.

It should be clearly understood by everyone concerned that the drawing takes precedence over the Standards Practice Manual. When drawing and standard conflict, the drawing prevails. Unless otherwise noted on the drawing, the applicable tolerances specified in the Standards Practice Manual should apply and not need to be repeated on the drawing. Engineering personnel who refer to the standard must be educated to understand that tolerances closer than those provided in the standard can be obtained, and when required should be specified on the drawing. It should be stressed, for the benefit of engineering personnel, that closer tolerances will increase costs. Closer tolerances will most likely require special tools, jigs or setups, along with higher skilled operators, closer supervision, and tighter inspection. When acceptable, wider tolerances than those specified in the standard, should be specified on the drawing. It is equally important that the point be stressed that the use of wider tolerances will decrease manufacturing costs. The illustrations—and there should be hundreds of them—used in the Standards Practice Manual, should be explicit and generally be complete only so far as is necessary to clearly illustrate the point in discussion.

As may be concluded, considerable progress in drafting has been accomplished. The quality of drawings has generally improved. However, there is obviously room for improvement. There is still a large degree of guesswork in drawings. The answer, to a large degree, is a Standards Practice Manual. Obviously, it is essential to supplement drawings by such a standing standard. When considering the merit of a Standards Practice Manual, here are some of the questions that require an answer: Is any document worthwhile that will make drawings noncontroversial specifications of engineering intent? Is further uniformity of practice required? Should something be done to simplify the whole complicated relationship between contractor and subcontractor? Is there any advantage in avoiding conflicting decisions on the part of engineering personnel? Should engineering specify reasonable tolerances? Is there any profit to be gained by avoiding possible rejection of usable parts? Can any benefits result from the avoidance of repeated effort? Should drawing revisions be held to a minimum? Is it good business to eliminate the number of time-consuming telephone calls and memoranda? Should new concepts in drafting be adopted, interpreted, and applied? If the answer is yes to these questions, then proceed at once to develop a Standards Practice Manual.

Typical examples and accompanying descriptions for definition and interpretation of terms are illustrated in Figs. 1 through 14. Figs. 15 through 24 present typical shop-run tolerances.

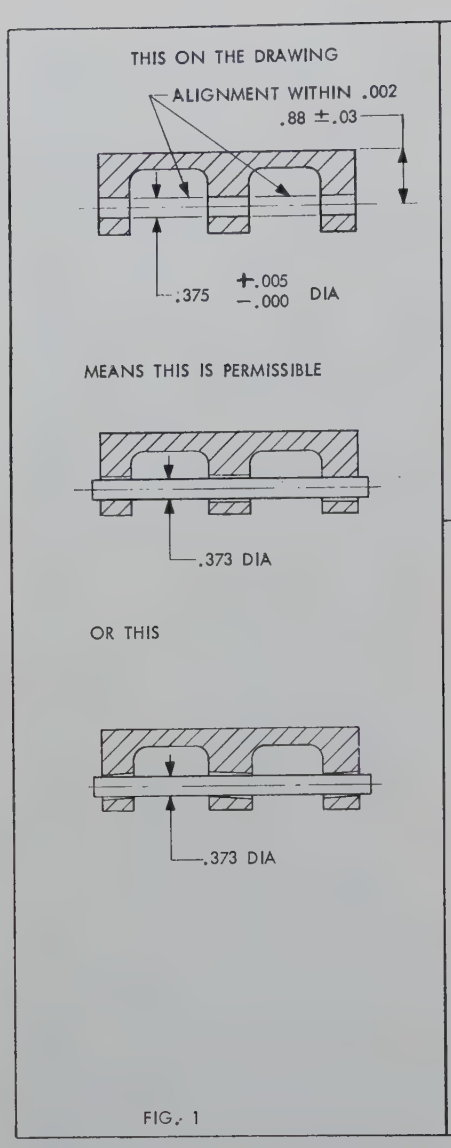



FIG. 1

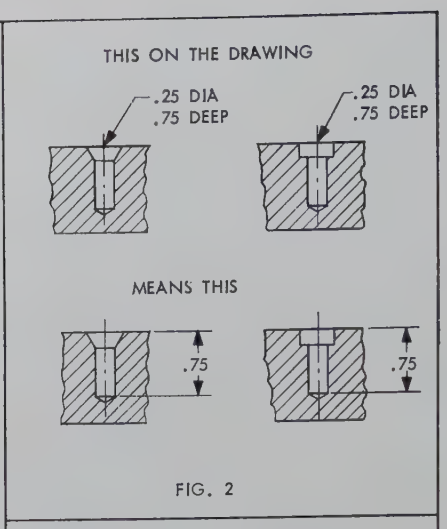



FIG. 2

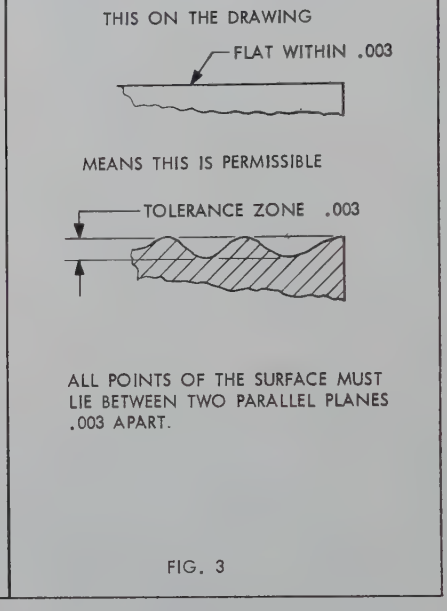



FIG. 3

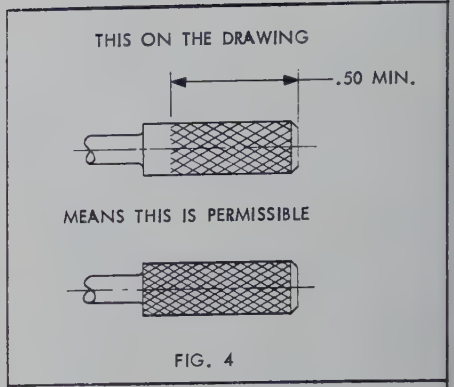



FIG. 4

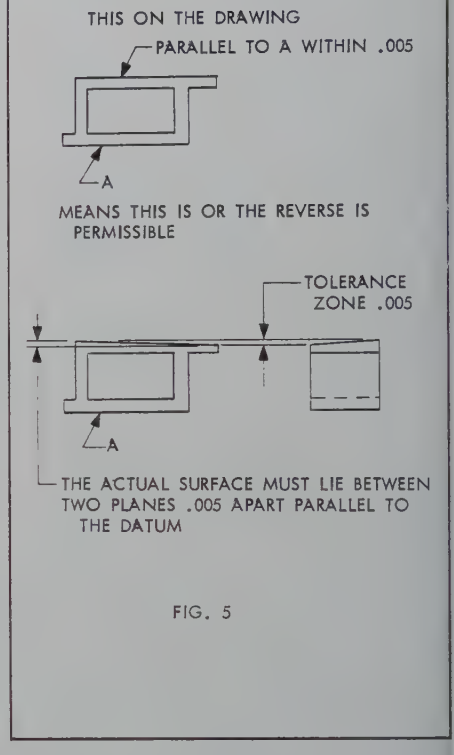



FIG. 5

# TYPICAL EXAMPLES OF DEFINITION AND INTERPRETATION OF TERMS

**Alignment:** Alignment requirements are met if a straight round gauge, having diameter(s) equal to the minimum hole diameter specified for each hole, minus the alignment tolerance, can pass through the holes. Hole sizes must not exceed dimensional limits. The three .375 plus .005, minus .000 diameter aligned holes are acceptable if they receive a straight .373 diameter gauge. See Fig. 1. The tolerance and alignment zone also defines the limits within which variations in squareness of the axis of the holes must be confined with respect to the surfaces. The .88 plus or minus .03 dimension locates the common axis (true position), but does not control alignment.

**Depth of Hole:** The depth of hole specified on the drawing shall be measured from the surface drilled to the depth of full diameter excluding the drilled point. See Fig. 2.

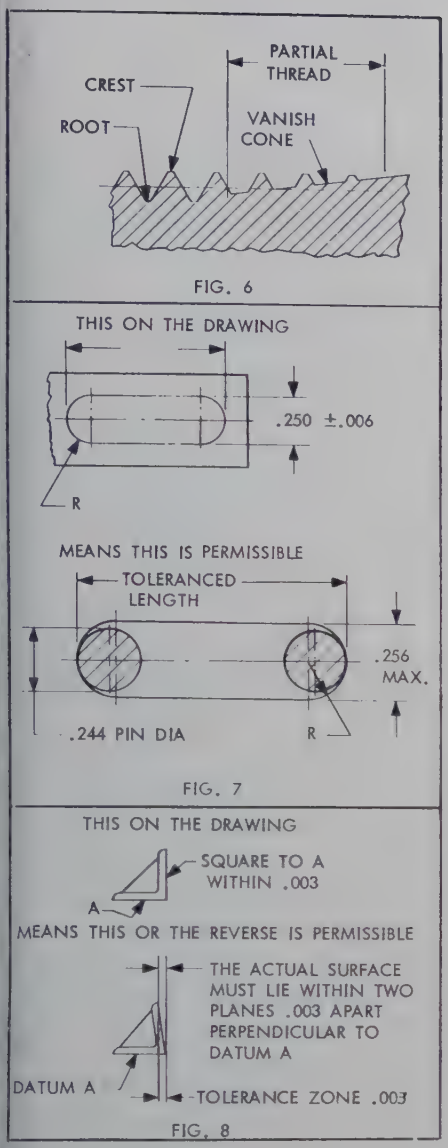
**Flatness:** Flatness is the condition of a surface which does not deviate from a plane. Flatness is controlled by specifying the permissible variation on the drawing or by shop-run tolerances. See Fig. 3.

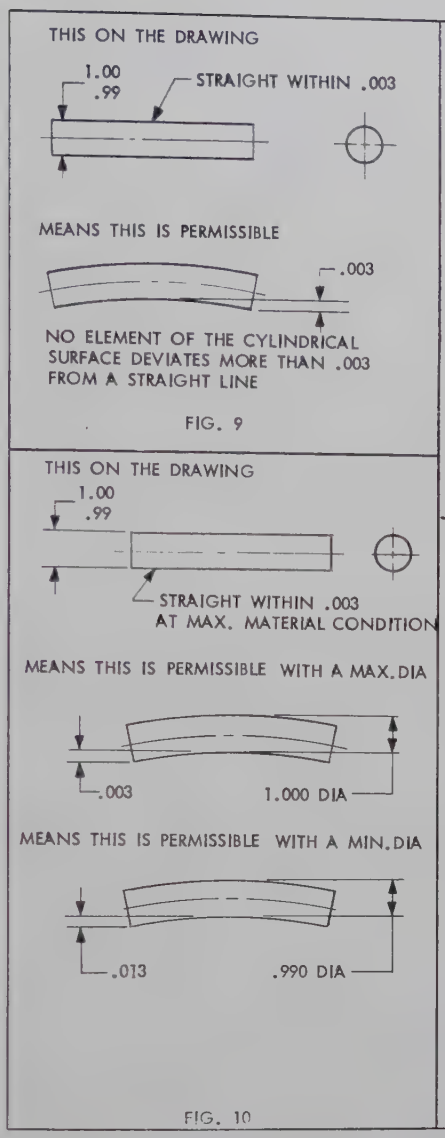
**Minimum (Min.):** The term "min.", when specified on the drawing, is to designate the lower limit of a dimension. The upper limit may be considered anything greater than the lower limit. See Fig. 4.

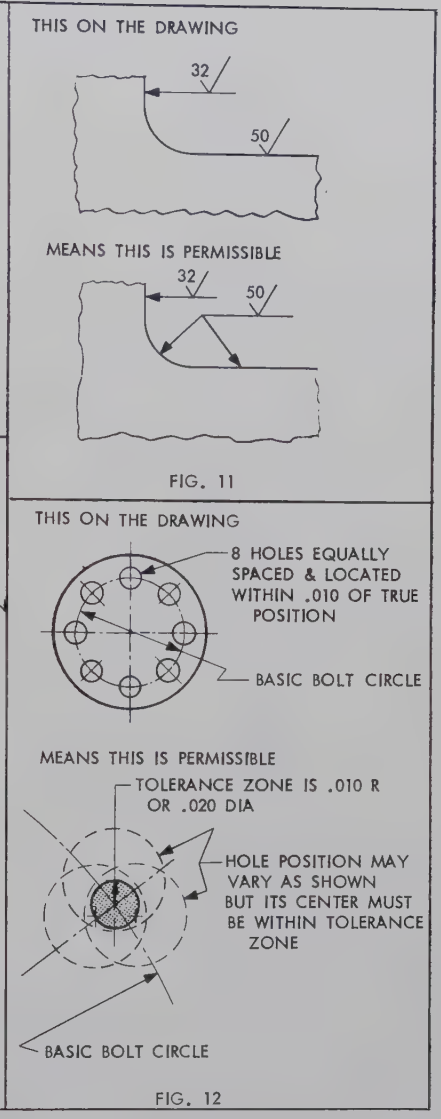
**Parallelism:** Parallelism is a condition wherein two or more planes or straight lines extend in the same direction and are equidistant at all points. Parallelism is controlled by specifying the permissible variation on the drawing or by shop-run tolerances. See Fig. 5.

**Partial Thread:** The partial (or incomplete) thread is that portion at the end having roots not fully formed by the lead or chamfer on the threading tools. This is also known as the vanish or washout thread. See Fig. 6.

**Slots with Rounded Ends:** Slots with rounded ends are dimensioned for size by width and over-all length with one end denoted by the abbreviation "R." The rounded ends need not be inspected as a radius value is not specified. It shall not be interpreted as a radius with one-half of the tolerance of slot width. The slot (for minimum width) is acceptable when measurement over pins is within the required toleranced length and pin diameter is equal to the minimum




width of slot. See Fig. 7. It should be noted that another gauge would be used to check maximum slot width.

**Squareness:** Squareness is the condition of surfaces which are at right angles (90°) to each other. Squareness is controlled by specifying the permissible variation on the drawing or by shop-run tolerances. See Fig. 8 as an example of how two planes are toleranced.

**Straightness:** Straightness is a condition where no element of a surface deviates from a straight line. Straightness is controlled by specifying the permissible variation on the drawing or by shop-run tolerances. See Fig. 9.

**Straightness at Max. Material Condition:** Straightness described by this term and with a stated tolerance means that this variation to true straightness may exist when the dimension to which it is applied is at its maximum limit. Conversely, the greatest variation to true straightness exists when the dimension to which it is applied is minimum. In Fig. 10, a .99-1.00 diameter pin designated by "a" is required to be straight within .003 at max. material condition. At condition "b" with the pin at 1.00 dia. a .003 out of straightness is shown. At condition "c" with the pin at .99 dia. a max. .013 out of straightness is permissible. Intermediate variations from .003 out of straightness to .013 out of straightness are dependent upon the variations of the pin diameter, .99-1.00.

**Surface Roughness of Blended Fillet:** The surface finish of a blended fillet may be the same magnitude as the rougher of the adjoining surfaces unless otherwise specified on the drawing. See Fig. 11.

**True Position:** The application of this term means that the part feature to which it is applied is located to a true or exact position by basic untoleranced dimensions. The amount of variance from this true position is then stated in a note. Fig. 12 shows an example of true positioning as applied to holes. The centers of the eight equally spaced holes are located by a basic untoleranced bolt circle dimension. This dimension plus the eight equally radial lines establishes the true or exact position of the hole centers. The note allows the manufactured hole center to vary around this true position within a zone tolerance of .010 radius or .020 diameter. Fig. 13 illustrates the relationship of the axis of an actual hole and the true position tolerance zone. In terms of the axis, it means that the axis of each hole at all sections along its length must fall within the specified cylindrical tolerance zone whose cen-

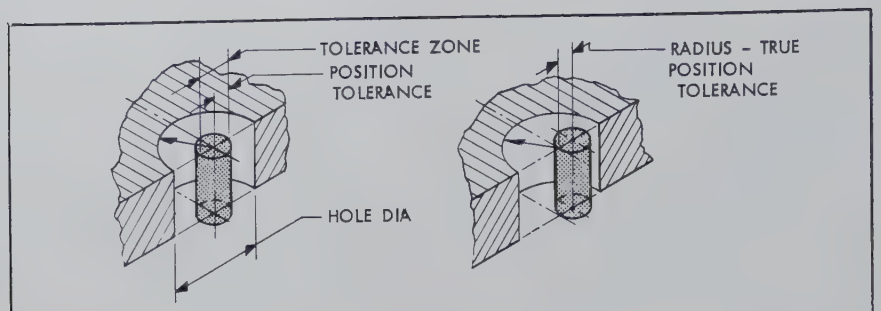



FIG. 13

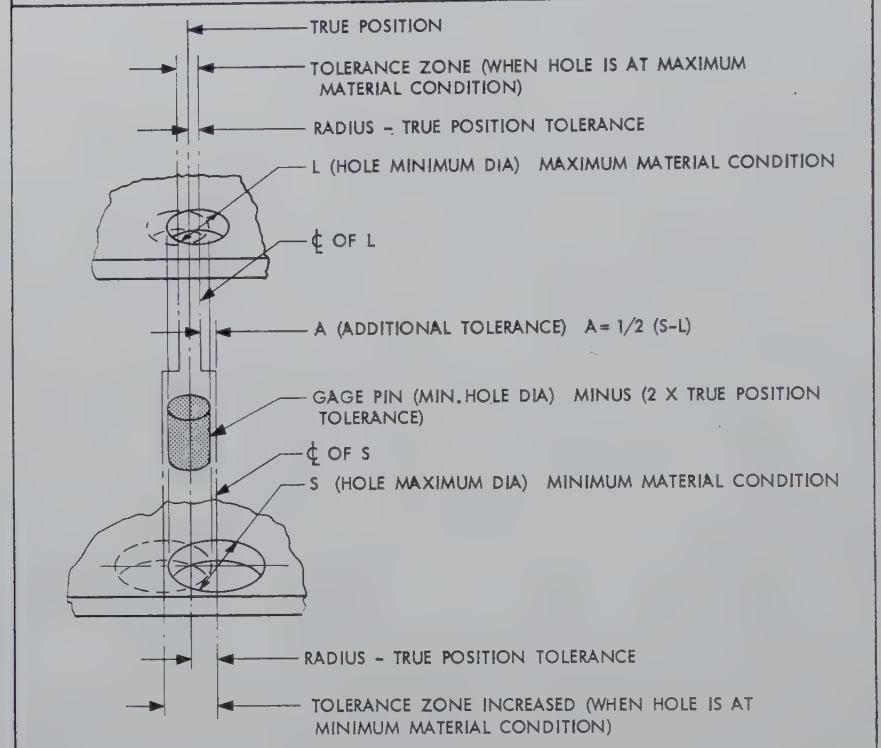



FIG. 14

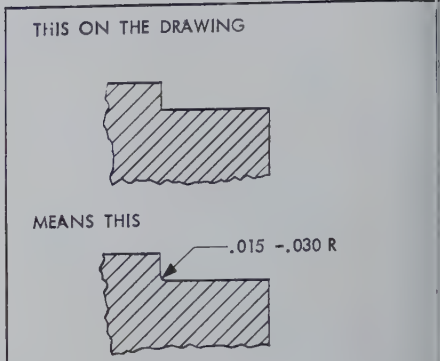



FIG. 15

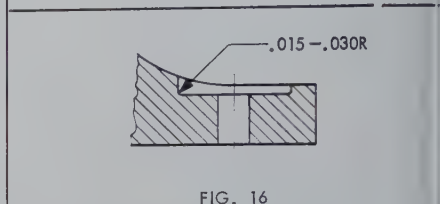



FIG. 16

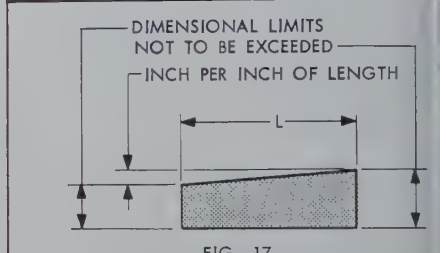



FIG. 17

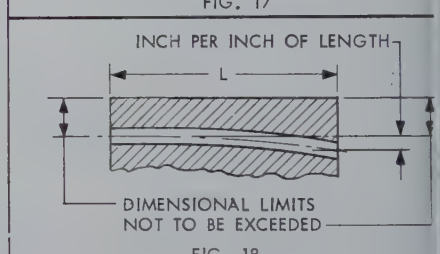



FIG. 18

ter is located at true position. Unless otherwise specified, true position tolerances apply at maximum material condition. At any condition less than maximum, an additional positional tolerance, equal to one-half the difference between the actual and the maximum material condition, (but not less than minimum) is permissible.

**True Position — Max. Material Condition:** The application of this term, when applied to holes, slots, or internal irregular shapes, means the holes, slots or internal irregular shapes are at their minimum limits. Conversely, this term applied to the exterior shapes means that these exterior shapes are at their maximum limits. True position dimensioning of holes or internal shapes shall be considered to apply at maximum material condition. At any condition, less than maximum, an additional positional tolerance, equal to one-half the difference between the actual and the maximum material condition, is permissible. Fig. 14 illustrates the foregoing, the "L" holes min. dia. is maximum material condition. The center of the "L" hole has been moved to the extreme right of the true position tolerance. The "S" hole maximum diameter is the minimum material condition. The center of this hole has been moved over an "A" distance. This places the edges of both holes in line. This permits the acceptance of parts that fall beyond the true position tolerance zone. The amount of a variance depends upon the hole diameter variance over the minimum shop-run tolerances.

# TYPICAL EXAMPLES OF SHOP-RUN TOLERANCES

**Corners — Fillets:** When a sharp internal corner is shown on a drawing, but is not specified, the fillet (radius) shall be from .015 to .030R. See Fig. 15. (This is an excellent way to avoid sharp corners. It is extremely important that fillets be as large as possible on parts subject to high stresses. Localized stress intensification is caused by sharp corners and can result in parts failure.

**Corners — Spotfaced Holes:** Spotfaced holes shall have a corner radius from .015 to .030. See Fig. 16.

**Parallelism:** Surfaces of machined elements shall be parallel to each other

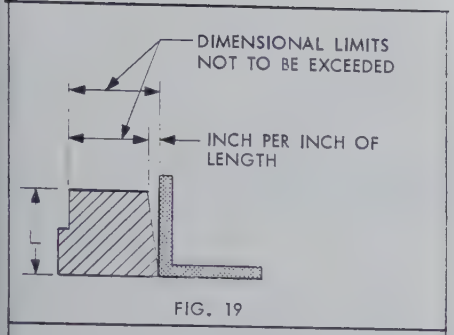



FIG. 19

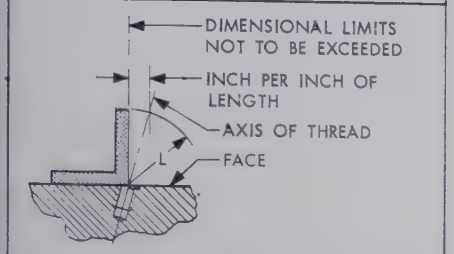



FIG. 20

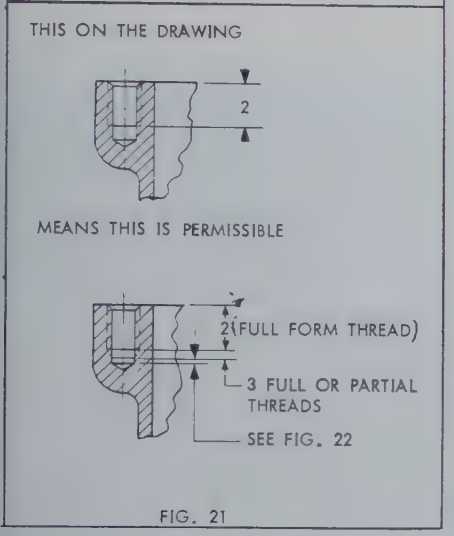



FIG. 21

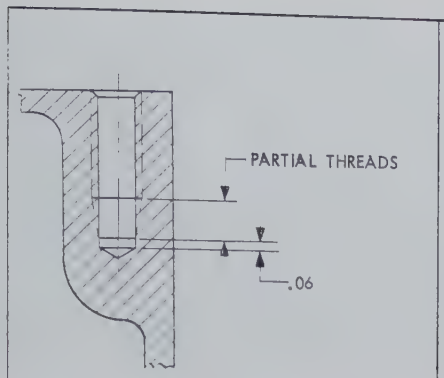



FIG. 22

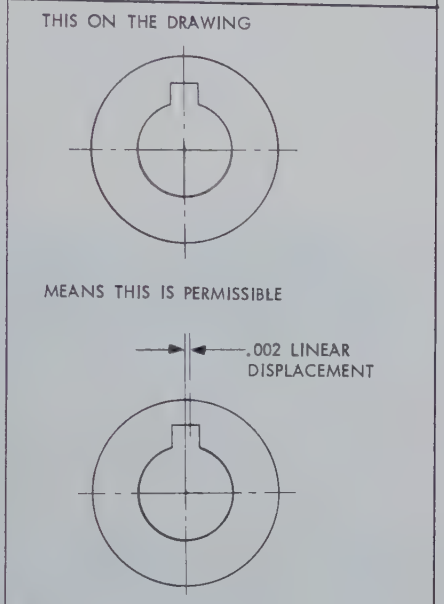



FIG. 23

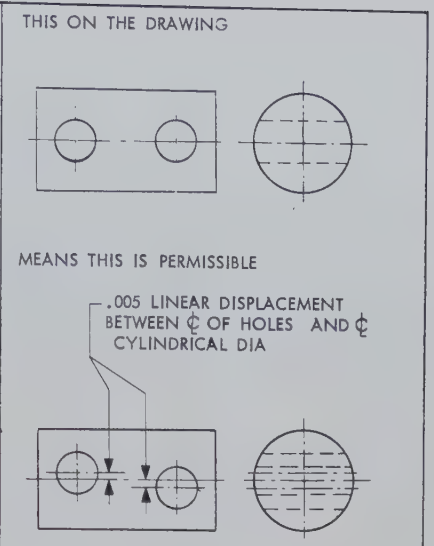



FIG. 24

within .002 per inch of length starting with a minimum of .002 up to a maximum of .015. See Fig. 17.

**Runout — Twist Drilled Holes:** The runout or eccentricity permitted for drilled holes shall be .003 per inch of length starting with a minimum of .003 up to a maximum of .015. See Fig. 18.

**Squareness:** Squareness of machined surfaces, other than turned surfaces, shall be .002 per inch of length (L) starting with a minimum of .002. See Fig. 19.

**Squareness — Threads:** The axis of threads must be square with the face within .005 per inch of length (L) starting with a minimum of .005. See Fig. 20.

**Thread Depth:** The thread depth dimension on the drawing is the gauging depth (depth of thread having full form). Where there is a countersink at the start of the thread for starting the tap, it is included in the depth of the full thread. Full or partial threads allowable beyond the specified depth is 3 threads. See Fig. 21.

**Threads — Tap Drill End Clearance:** Tap drill end clearance shall be .06. See Fig. 22.

**True Position — Keyways:** Keyways shall be located within .002 true position tolerance. The true position tolerance shall be related to the hole or shaft diameter, whichever is applicable. See Fig. 23.

**True Position — Holes on Cylindrical Surface:** Holes shown on the centerline of a cylindrical surface shall be located within .005 true position tolerance. When more than one cylindrical surface is involved, the true position relationship shall still apply to the outer diameter. See Fig. 24.

## *The Author*

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# FASTER PHOTO-DRAWINGS

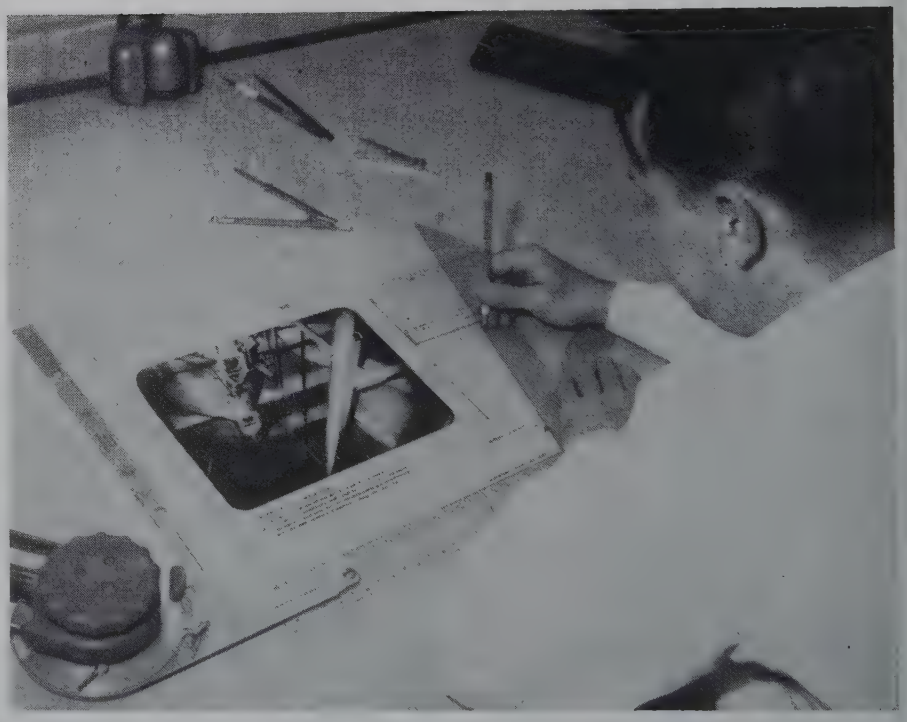
*Monsanto perfects simple technique combining two-minute slides, projection, and a diazo set-up*

by Clayton B. Hammond

WE HAVE developed a fast, simple method for providing our plant maintenance crews with detailed work orders for complicated repair and installation projects. The method has cut our drafting time by 30 percent and greatly improved the over-all efficiency of our plant maintenance program.

Employing a rather unique combination of on-the-spot photography and diazo-type reproduction, the new technique enables us to produce detailed 11-x-17-inch illustrated work orders in less than one hour. Handed to workmen in place of complicated engineering drawings, the graphic work sheets show exactly what has to be done, where and how it should be done, and what the finished job should look like.

As a result, workmen know exactly what each project entails without having to spend time "translating" hard-to-understand engineering specs; can complete a major revision or installation in far less time than ever before.



**AFTER THE enlargement of the Polaroid transparency has been burned into the sepia master sheet, a draftsman sketches the proposed installation on the enlarged diazo image. In the blank area of the master he adds supplementary sketches and information which will help workmen complete the job. This master sheet is then fed through a standard diazo-type copying machine for the desired number of copies.**

## NEW PROCEDURES

OUR NEW METHOD, perfected after almost two years of on-the-job trials, utilizes black-and-white slides —developed on the spot—showing every detail of the installation area or equipment requiring modifications.

Made possible by our use of Polaroid Land Projection Film — which produces a top-quality slide in two minutes in a regular Polaroid Land Camera—the instant slides are projected onto a highly sensitive sepia diazo paper to produce an enlarged diazo "print" anywhere from 7¼″x9¼″ to 28″x32″.

This enlarged "master print" is combined with simplified supplementary sketches of the work required and typewritten "steps" explaining how it should be done, and the sepia master is then reproduced in a standard diazo-type direct copy machine for distribution to our plant maintenance crews.

The easy-to-read diazo "photo-drawings" enable workmen to tackle the most complicated installation and maintenance projects with a thorough understanding of what has to be done.

Our research on this unusual photo-drawing technique actually began about four years ago when we started using Polaroid black-and-white paper prints in our maintenance operations.

Whenever we had a repair or installation job to do, a plant engineer

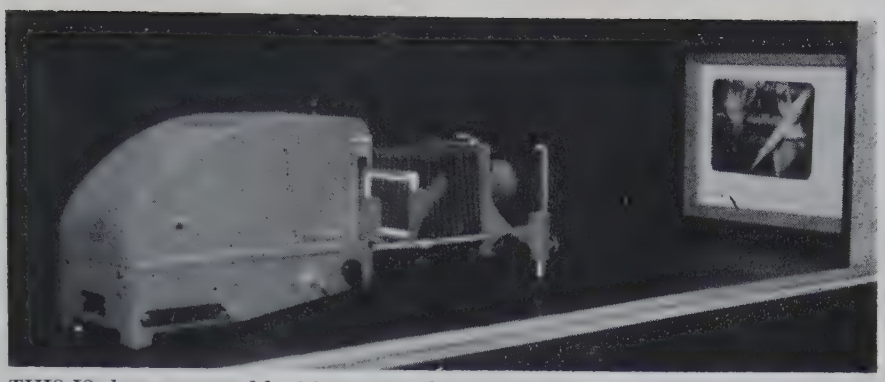
photographed the work site or equipment with one of our department's three Land Cameras and attached the one-minute pictures (now 10-second) to printed data cards containing detailed specifications on the project.

This technique was highly successful. Workmen could see at a glance just what had to be done, and the performance time on these assignments was cut drastically.

As example, we assigned two work crews to identical jobs at opposite ends of the plant. One crew was provided with Polaroid photos of the existing facility with the proposed installation sketched over them. The other group had to work from a detailed written description only.

The result: The crew aided by on-the-spot photos completed their job in half the time required by the second group.

But, while this technique proved successful on relatively simple jobs, it was of little value on very complex assignments, because it was extremely difficult to describe adequately a complicated installation or renovation with only one or two pictures attached to a small data card.



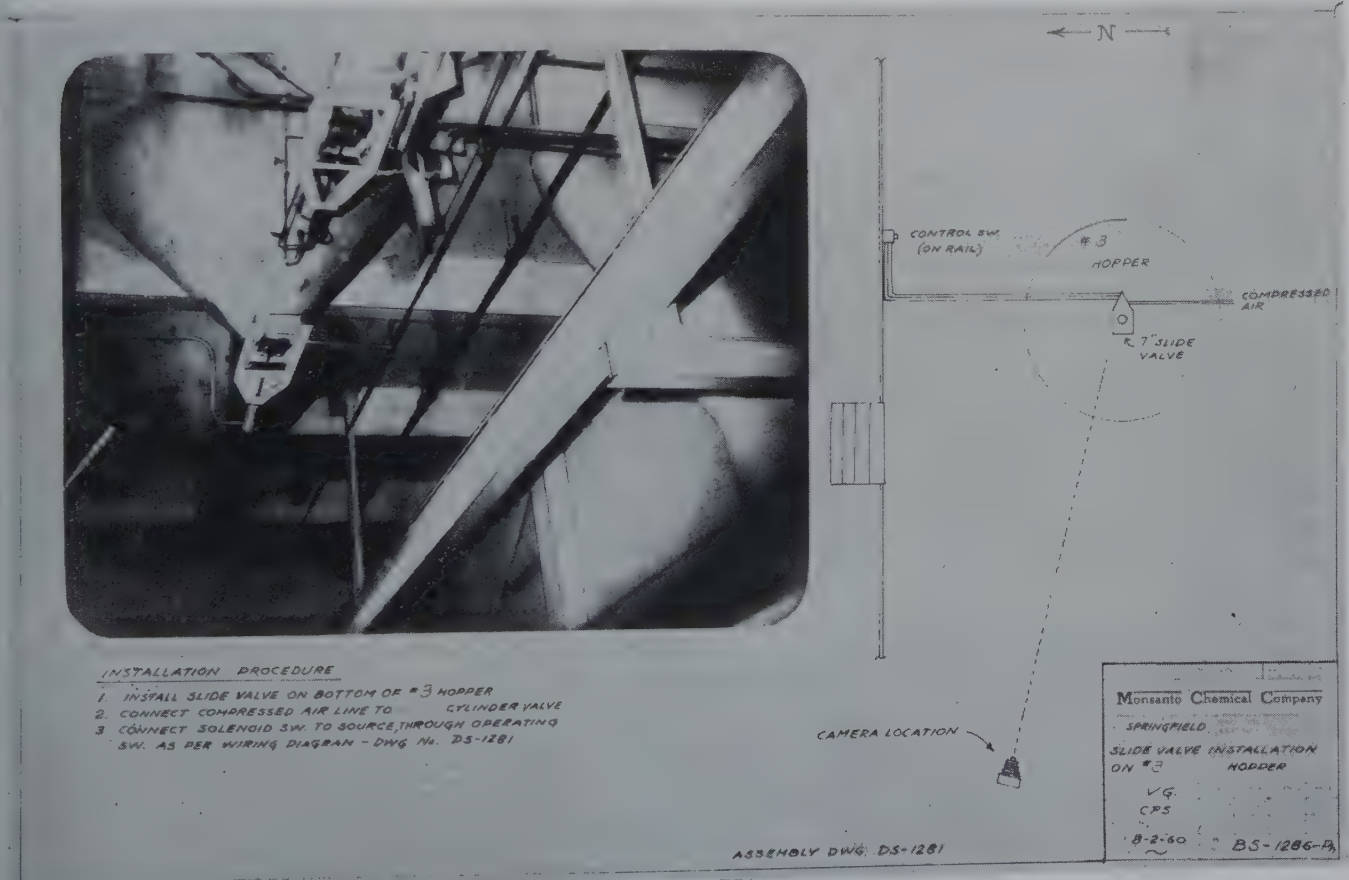
**THIS IS the set-up used by Monsanto's plant engineering department when projecting a Polaroid transparency. The slide is mounted in glass and inserted into their Beseler-lantern-slide projector. The image, enlarged to 7¼" x 9¼", is projected onto a sepia master sheet which is taped to the wall to receive the image. This simple method of producing detailed work orders has cut their drafting time by 30% and greatly improved the over-all efficiency of their plant maintenance program.**

In an effort to find an effective way of producing quick graphic presentations for complicated assignments, we began experimenting in October, 1959, with Polaroid two-minute slides enlarged onto diazo master sheets.

### In-Plant Lighting

One of our biggest problems was taking the slides "live" in the plant. Although the Land Projection Film is fast (800 ASA, daylight equivalent), it is not fast enough to be used with only the available light in our production areas. And because much of our equipment is located in classified safety areas, we cannot use flash or flood lighting when taking photographs in the plant. As a result, most of our slides were too dark.

To get around this problem, we have continued taking pictures in the plant with Polaroid's 3000-speed




**THIS IS the actual work order which was made from a Polaroid two-minute transparency in Monsanto's plant engineering department. These easy-to-read photo-drawings enable workmen to tackle even the most complicated installation and maintenance projects with a thorough understanding of what has to be done.**

**THIS FLOW chart traces the step-by-step evolution of the 11" x 17" illustrated work orders. The completed photo-drawing—from the time the two-minute Polaroid transparency is made until the last diazo copy drops out of the copying machine—takes about one hour. Left to right: STEP 1, Polaroid transparency showing work to be done is taken and slide mounted; STEP 2, Enlarge on sepia paper using standard projector; STEP 3, Sepia print is developed through processing section of diazo machine; STEP 4, Dimensions and revisions are added to enlarged photograph which may be mounted on a standard drawing base. Additional sketches and information may be added to the drawing, adjacent to the picture; STEP 5, Completed drawing is processed in usual manner.**

paper-print film. This film is so fast we can take pictures using only the existing light and still get the detail and contrast we need. Once we have a sharp picture, it is a simple matter to copy the print with Land Projection Film to get a good two-minute slide.

For example, suppose we had to install a sliding valve on the bottom of a large hopper used to dispense powdered chemicals.

We first photograph the underside of the hopper with a Land Camera loaded with 3000-speed film, and ten seconds later we have a finished print showing every detail of the hopper construction.

We place the instant picture on the easel of our Polaroid Copymaker—a portable unit containing built-in lights and lenses for copying small objects, like photographs. We attach a second Land Camera to the Copymaker's mounting post, and photograph the print with Type 46-L Projection Film.[1]

Two minutes later we have a black-and-white slide of the hopper, and after immersion for 20 seconds in a hand-held "tank" (called a Dip-pit) of emulsion-hardening solution, the slide is mounted between two pieces of glass to prevent buckling which might occur because of prolonged exposure to heat during projection.

Because many of our pictures are made under the most adverse lighting conditions, we sometimes have to work from slides that are somewhat dark and with little contrast. However, we can still obtain satisfactory enlargements from them by resorting to two simple "dodging" techniques which we have perfected.

The first is used when a slide is composed mostly of harsh black areas, with little white or grey. We've found that by placing a magenta contact screen over the sepia master sheet during projection, we can reduce the tonal range of the image—softening the blacks and highlighting the whites to create more contrast.

The second, and more frequently used "dodge" is employed when the part of a slide we are most interested in is a broad line—piping, electrical wiring, ductwork, etc.

In this case, we make a negative diazo print of the Polaroid slide by running the transparency through our diazo machine with diazo reversing film. We then overlay the slide and the negative when we project them, setting them slightly out of register. This technique has the effect of strengthening the broad lines we want seen, in addition to reducing the tonal range.

Although the results of these techniques are less than perfect photographically, they are more than adequate for our needs.

### Diazo Image Projected

After the slide is mounted in glass, it is projected onto a blank wall while we focus the projector—we use a Besseler lantern-slide projector with a 750-watt lamp. Then we tape an 11- x 17-inch sheet of Tecnifax sepia diazo paper to the wall to act as a "screen," and position the projector so that the 7¾- x 9¼-inch enlarged image falls on the upper left portion of the master sheet. We project for about 30 minutes, interrupting the projection at intervals to check the progress of the image being "burned" into the sepia paper.

(During the actual projection it is not necessary to have the room completely dark. We simply turn off the overhead light and draw the window shades to eliminate unwanted random light.)

When we have the desired gradient (color tone) we want on the sepia master, we remove it from the wall, run it through the process section of our diazo-type copying machine, and give it to a draftsman who sketches the proposed valve on the enlarged diazo image of the hopper. He then makes a simple line drawing on the blank area of the master to the right of the enlarged photo image showing the position of the valve, the route of the electrical wiring, and the location of the control switch to which the valve should be wired.

Once this is done, the sepia master is fed through our Ozalid diazo-type direct copying machine with Tecnifax 28S Diazo-Blue paper until we have the number of copies we need. These copies are then forwarded to the maintenance crew assigned to install the valve.

The completed photo-drawing—from the time we shot the original Polaroid print until the last diazo copy dropped out of our Ozalid machine—took about one hour.

Our diazotype-slide system has proven so successful here at Springfield, that it is now being used in other Monsanto plants throughout the country.

---

[1]The Land Projection Film is available in two sizes: Type 46, which produces a 2¼-inch-square slide for use in a special Polaroid projector, and Type 46-L, which makes 3¼- x 4¼-inch slides for use in standard lantern-slide projectors.)

## *The Author*

Clayton B. Hammond is Superintendent, Engineering Section, Plant Engineering, Monsanto Chemical Company, Springfield, Mass.

# DRAWING FOR OPTICAL PROJECTION

*Procedures developed by Allis-Chalmers York Works permit faster layout work*

**DEVELOPMENT** draftsmen making accurate layout.

AN OPTICAL projection method for flat plate layout is saving considerable time and permitting better use of materials at Allis-Chalmers York (Pa.) Works, where it is being used in the fabrication of hydraulic turbine components and large valves.

The Lumotrace process involves preparation of the drawings, photographing them, developing the glass negatives, projecting them in full scale on plate steel, and tracing the markings.

**INKING** a completed development layout.

After analyzing the design department's steel assembly drawings, the draftsman makes the layout drawings in 1/10 scale with special instruments and magnifying glasses on special sheets of white paper with aluminum backing for high dimensional stability. He traces in ink on translucent plastic. Duplicate shapes are nested where possible for best utilization of a standard plate.

The drawing is then photographed by a vertical Lumotrace camera and reduced 1/10 on a 3¼- by 5-inch glass negative. This negative is used in a high-precision Lumotrace projector housed in a cubicle in the trusses of the plant roof about 50 ft. above the work level and reached by an enclosed elevator. The layout work table was permanently leveled and adjusted during installation to eliminate any distortion.

The rigidly mounted projector has a high pressure, water-cooled mercury light and an air-cooled, high precision Zeiss lens. The projected image is magnified 100 times to full scale on steel plate. The projector holds up to three separate slides and each negative may have drawings for six or eight full plates. As a result, twenty-four 90- by 240-inch steel plates can be marked before the negatives need be changed.

The operator goes up to the projector only to load and remove negatives. It is possible for him to move the projected image along the table or across the table or to rotate it by

**COMPLETED development drawing being photographed on a 3¼- by 5-inch plate.**

means of a pendant control with no more than 1/16-inch error over a 40-ft. distance.

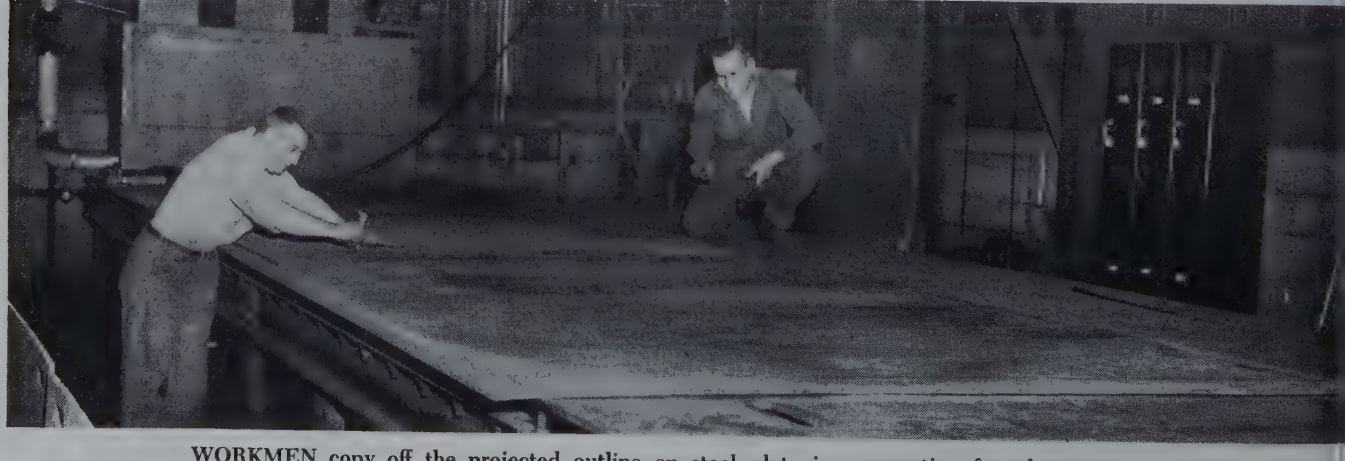
By following the projected outline, steel plates are marked with a center punch and hammer; written instructions are traced with paint, and locations of cutouts or other pieces are marked, after which the plate is fabricated. Where identical pieces are to be marked, the negative is left i focus until all plates are marked. Th possibility of errors at assembly reduced since more information ap pears on the negative than with th normal layout technique.

Since the projected image is ful scale, no interpretation is needed complete instructions are on the draw ings, and markings can be don around the clock. Re-usable slide are stored in an office file and ar easily accessible for duplicate jobs.

Savings in time and material a well as handling are being realized b this method because a careful ar rangement on the drawing can util ize all areas of the plate. The camer unit can also be adapted for micro film photography of records.

The real value of Lumotrace i realized in the fabrication of dupli cate pieces and in the larger volum of work that can be handled. Th time savings are most important be cause all development layout wor can be performed by the time th steel plate is delivered; in the forme method, it was necessary to wait un til the plate was received for thi operation, a factor which directl affected delivery time of the finishe product.

**OPERATOR placing glass plate in projector.**



**WORKMEN copy off the projected outline on steel plate in preparation for glass cutting.**

# Are your bookkeepers better equipped than your engineers or draftsmen?

You certainly want your bookkeeping department to have the latest equipment to maintain accuracy and output—but your highly trained professional engineers or draftsmen need today's tools, too—for the high production efficiency you've a right to expect.

## Your draftsmen, your productivity, deserve new Hamilton space- and time-saving equipment from Ridgway's

Inefficient, obsolete equipment in your drafting department may be *stealing dollars* from you every working day! Top professional draftsmen work better, work smarter, make fewer errors when they use premium-quality Hamilton equipment. Boosts morale, too! Watch *your* top men respond to the professional challenge of smart modern Hamilton units engineered to fit your needs. Learn why thousands of firms have selected Hamilton year after year . . . call our designers for planning help without obligation, of course.

**HAMILTON L-CONTOUR TABLE** Sturdy, counter-balanced drawing surface travels full 20″—permitting frequent position change, greatly reducing fatigue—quickly adjusted to individual requirements for each individual job. Board completely stable in all positions, horizontal to vertical. Modular construction permits arrangements to suit specific needs — right or left reference desk position optional. Ruggedly made, durably finished with long-life drawing and reference surfaces.

**Hamilton Unit System Files**
Provide full protection, accessibility, and classification for all materials to be filed. Occupy minimum floor space.

**Hamilton Auto-Shift Table**
Built-in mechanism adjusts board to individual height and slope requirements, provides full accessibility, reduces errors.

**Hamilton CL 100 Drafting Table**
Conserves dollars, yet rugged canted-leg design provides modern styling and convenience with long-term durability.

**Ridgway's** LLR

**There's a Ridgway's near you.**

in **HOUSTON,** Texas
615 Caroline
3800 Greenbriar
Bank of the Southwest Arcade

in **AUSTIN,** Texas
309 W. 10th Street

in **CORPUS CHRISTI,** Texas
516 Lawrence

in **DALLAS,** Texas
933 N. Central Expressway
933 Republic National Bank

in **NEW ORLEANS,** La.
433 Dryades Street

in **SHREVEPORT,** La.
719 Marshall Street
Petroleum Tower Building

in **TULSA,** Okla.
701 S. Cincinnati
5925 East 15th

in **JACKSON,** Miss.
103 East Pearl

in **IRVINGTON,** N. J.
1206-16 Grove Street

in **CHICAGO,** Ill.
10130 Franklin Avenue
Franklin Park

in **DENVER,** Colo.
1522 Glenarm Place

in **LOS ANGELES,** Calif.
590 So. Monterey Pass Road
Monterey Park

in **NEW YORK,** N. Y.
110 W. 42nd Street
216 E. 49th Street

in **FORT WORTH,** Texas
309 Main Street
3312 Fairfield

**Ridgway's Dealers Coast-To-Coast**

# New Products

## Pushbutton Tracing

A new process for transferring drawings to an illustration material before rendering has been developed by West Reproduction, P.O. Box 2336, Ft. Dearborn Station, Dearborn, Mich. Called Trace, the diazo-type sensitizing solution is applied to a surface in a spray from a 12-oz. pressurized container. Any well-prepared translucent sketch, pencil or ink drawing, film positive, or transparentized opaque matter such as photographs and stats can be transferred immediately. Among the advantages: no darkrooms needed for processing, immediate copy, elimination of many tracing hours, adaptability to light or heavy weight illustration material.

## Thermal Reproduction Paper

A new white, plastic-coated thermal reproduction paper of "regular weight stock" which will give "excellent" reproductions with greater contrast, has been announced by Stylograph Corp., 205 W. Main St., Rochester, N. Y. The Type-S supplements a previously announced Type-W. The paper is described as being lower priced than comparable thermal reproduction type papers, yet offers greater permanency, and durability. Additional details are available from the manufacturer.

## Oversize Photocopier

Champion 18, a new photocopier designed for copying oversize originals up to 18″ wide, and of any length, has recently been put on the market. Ideal for copying large drawings, blueprints, plans, charts, ledger sheets, and 16-column paper, the machine's extra width enables two operators to work simultaneously when making 8½ by 11″ copies, doubling production and eliminating waste time. The unit produces pure white copies of any original printed, drawn, ink or pencil written, on colored, transparent, translucent, or opaque stock, with little or no exposure adjustment. For futher information, write Copease Corp., 425 Park Ave., New York 22, N. Y.

## Automatic Map Maker

A new automatic model Map-O-Graph "55" has been announced by Art-O-Graph, Inc., 4837 Emerson Ave., S., Minneapolis 9, Minn. The vertical opaque projector has remote electric controls for high precision focusing and operating convenience. Its design improvements include an increased range of 5-time enlargement and reproduction, an improved track mechanism, and a cast-aluminum stand with option of leveling feet or brake casters. Maps of any width or length can be handled and any 11″ by 11″ section can be enlarged or reduced up to five times in perfect scale. The Map-O-Graph is a vertical model, and can be used with any type of table.

## Magnetic Control Board

A new magnetic visual control board has been designed for plant planning and layout. Marketed by Methods Research Corp., 105 Willow Ave., Staten Island 5, N. Y., the board eliminates needs for cumbersome horizontal planning boards with a gridded magnetic steel board which holds firmly engraved magnetic models. Manufacturer sees this as an asset in planning new buildings and facilities, in doing layouts for printed circuits and radio and television tube settings, etc.

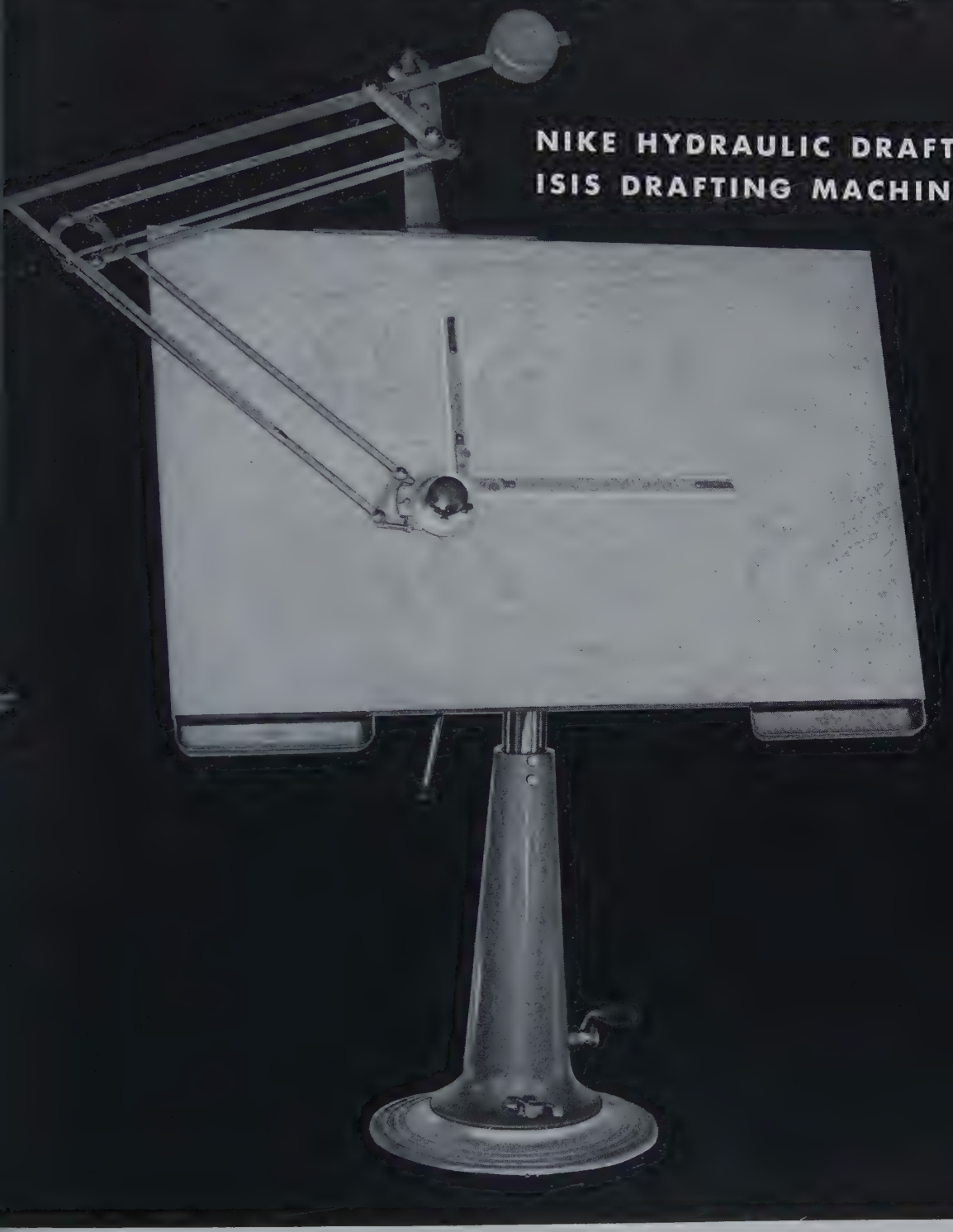
## Aperture Card Copier

Two thousand copies of original aperture cards can be made in an hour on the new Filmsort Uniprinter O41, with a minimum of manual control and only periodic attention during operation. The machine cuts direct labor burden in technical print preparation since whiteprinter, additional camera, processing, and printing times are eliminated. The manufacturer estimates that the new printer can do in one or two man hours what would take up to seven using regular reproduction methods. In the distribution of engineering data for use or reference, the new copier fills several needs: production of multiple decks of aperture cards for initial distribution to various locations with speed and economy; duplication of original film for establishment of files in new areas where point-of-use reference is desired. The Uniprinter stands 53″ high, 29″ wide, 84″ long, and weighs 1,500 pounds, and costs $25,000 installed. More information available through the manufacturer, Microfilm Products, Minnesota Mining & Manufacturing Co., Dept. SI-51, 900 Bush Ave., St. Paul 6, Minn.

## Flexible Whiteprinter

A new whiteprint machine with a sleeveless developing system designed for maximum convenience and flexibility has been introduced by Ozalid Division, General Analine and Film Corp., 69 Corliss Lane, Johnson City, N. Y. Called Printmaster 900, the machine reproduces engineering and architectural drawings, visual aid materials, a wide variety of business forms. It accommodates materials of any length and of widths up to 42″ and printing and developing speeds are synchronized up to 75′ per minute. The system protects sensitized film from scratching, eliminates need for slip sheets. Double-coated materials develop in one pass as both sides are simultaneously exposed to developer. Entire developer unit slides out from back for simple servicing. Feed assembly, positioned well forward on machine feed board, eliminates dog-eared or folded corners.

*a new turn to drafting . . . with a power lift*



**NIKE HYDRAULIC DRAFTING TABLE**
**ISIS DRAFTING MACHINE**

# To Free Creative Minds From Manual Tasks

The table with the greatest adjustment range, full circle rotation, cleanest appearance, and least space requirements.

The drafting machine most accurate at the scales . . . where it counts.

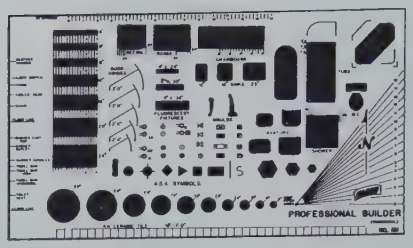
FULL DETAILS FROM ISIS INC., BOX 1062, YORK

## Reservoir Pen

The Leroy reservoir pen, capable of holding enough ink to draw a straight line approximately 1,200 feet long, has been introduced by Keuffel & Esser Co., Third and Adams Streets, Hoboken, N. J. Ink supply is contained in an airtight, nonporous, translucent cartridge, and is always visible. Pen is available is seven point sizes, from 00 to 5, and can be used with any Leroy lettering scriber.

## New Drawing Instrument

Combining the advantages of a protractor, straight edge, and scales in one instrument, the new Draft-All Triangle has recently been introduced on the market by Draft-All Triangle Co., 152 W. 42 St., New York 36, N. Y. Four popular scales (1″, ¼″, 1/6″, and 1/10″) are permanently stamped into a standard 8-inch, 45/90 degree plastic triangle. Easily stored or carried, it is designed primarily for off-the-board drawings, field work, or those who make occasional drawings but do not have regular drafting equipment.




## Builders' Template

Builders and manufacturers of equipment for builders were consulted in the development of a new builders' template now on the market by Roark Template Co., 3803 E. First St., Fort Worth 11, Texas. New template has the latest symbols and openings required by architects, has scale of ⅛″ = 1′, and sells for $2.50.

## High-Speed Diazo Blue Paper

A new diazo paper (Catalog No. 214S) for users who wish to achieve higher production without sacrificing print quality is now being produced by Tecnifax Corp., 195 Appleton St., Holyoke, Mass. The new paper offers 20-25-percent faster exposure speed with no loss in line density, according to company spokesmen.

## Imported Drafting Machine

Direct sales to the user and a satisfaction-or-money-back guarantee is reported to be the initial sales program to launch a new imported precision drafting machine, the MG22. The new machine incorporates the accepted band-and-pulley principle of American-manufactured machines, includes almost all desirable features of domestic drafters plus some exclusive features of its own, yet sells substantially below domestic models. Further information is available by writing Pasadena Technical Supply Co., 789 Raymond Ave., Pasadena, Calif.

## Easier Plate Repairs

A new product which makes it possible to add to a plate image after development has been announced by Minnesota Mining & Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn. The product, 3M brand Plate Tusche, is the first chemical to make it possible for a platemaker or pressman to fill in breaks in solids or to repair broken lines and letters on pre-sensitized plates without using mechanical methods.

## New Drafting Equipment

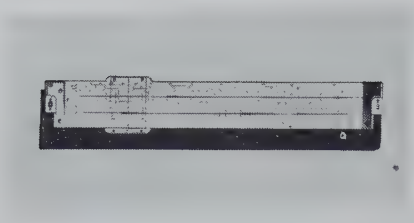
Two new imports of Isis, Inc., Box 1061, York, Pa., are the Nike hydraulic drafting table and the Isis drafting machine. The Nike table represents a radical departure from tables currently on the market in that it is made with a pedestal, fits into the smallest space requirements for a full-size drafting board, is stable without any floor attachments. Its vertical traverse is nearly 2′, angle adjustments range from horizontal to vertical, and the board can be rotated freely 360° around the base—like a barber's chair.

The Isis drafting machine, balanced for effortless manipulation at any board angle, has a system of arms of the parallelogram type, with an anchor bracket extending over the board to permit free and complete traverse of the scales over the entire board.

Both these products are pictured and described in a free brochure available from the importer.

## Graph Sheet Packages

New graph sheet packages with "see-through" panels have been introduced by Keuffel & Esser Co., Adams and Third Streets, Hoboken, N. J. The transparent windows make it easy to spot line color and grid size of the graph paper. Each package contains 100 graph sheets in either of two sizes— 8½″ by 11″ or 11″ by 16½″. Packages are designed to serve as file folders; self-adjusting construction accommodates either a full load or a single sheet without causing the paper to warp or sag when the package is stored vertically.



## Bamboo Slide Rule

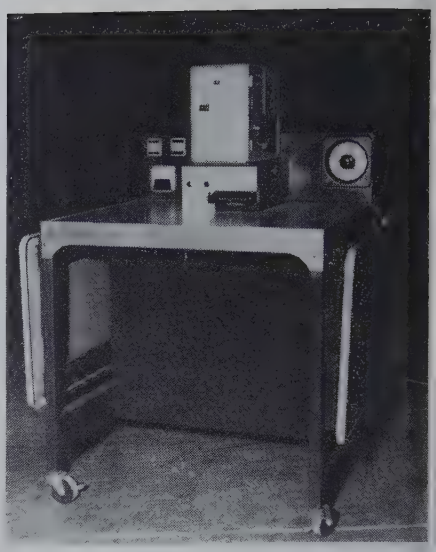
A durable, specially treated bamboo slide rule, complete with ivory white plastic facing for improved readability, has been introduced on the market by Alvin & Co., Inc., 611 Palisado Ave., Windsor, Conn. Easy readability, insured accuracy, and self-lubricating features are assets of the bamboo rule, the Elite. The use of bamboo is claimed to make the rule a major improvement in the technical field because of bamboo's inherent quality of neither expanding nor contracting with changes in temperature or climatic conditions. Elite comes in three 10-inch models, designed for mechanical engineers, advanced electronics engineers, and scientists.

## Drawing Pencils

Cedarwood pencils in a new line, tradenamed Paramount, are offered by Alvin & Company, Inc., 611 Palisado Ave., Windsor, Conn. Paramount "Diamond" drawing pencils have opaque leads carefully graded in 18 degrees. They are extra strong, noncrumbling, and sharpen to a fine, clean point. Paramount "Star" drawing pencils, priced slightly lower than "Diamond" pencils, are offered in 10 degrees of hardness. Paramount "Chrome" pencils are available in 12 colors; they are suitable for sketching, marking and checking.

## Book Reproduction

After two years of experimentation and testing, Micro Photo, Inc., 1700 Shaw Ave., Cleveland, Ohio, has announced a process for the two-sided reproduction of book pages. Called Duopage, the method utilizes the electrostatic principle plus an entirely new technique.



## Improved Film Printer

A new unit to expand the versatility of microfilm mounted in aperture cards has been announced by Recordak Corp., subsidiary of Eastman Kodak Co., 415 Madison Ave., New York 17, N. Y. The Recordak Card-to-Roll film printer is designed to copy negative or positive microfilm images, mounted in Military D-type aperture cards, onto roll film.

# New Literature

**Photocopying Papers and Films** are featured in six pages in the February issue of "Anken Photocopy News." The special papers-and-films section describes more than two dozen diffusion transfer photocopy papers and films, both negative and positive, and charts many of the special uses for various combinations of these materials. Copies of this publication are available free by writing Anken Chemical & Film Corp., Newton, N. J.

**Templates and Lettering Guides** are the subject of Catalog No. 561 of Roark Template Co., 3803 E. First St., Fort Worth 11, Texas. The catalog is divided into five categories for simplified use: general, architectural, electrical, ellipses, lettering guides. The catalog is fully illustrated and prices are included.

**A New Six-Page Brochure** giving details on the Pack Interlock Files and Filing System has been published by Pack Manufacturing Co., P.O. Box 508, Logan, Utah. The brochure is illustrated, gives details of adaptability of Pack files to various uses in connection with safe filing and storage of drawings, patterns, prints, maps, and other documents.

**Drafting Instruments and Templates** are illustrated, described, and priced in the current price list of the Dolgorukov Manufacturing Co., 407 Fisher Building, Detroit 2, Mich. The eight-page list is available through the manufacturer.

**Cronaflex Projection Film and its Use as an Offset Printing Plate** is the title of a technical bulletin recently issued by the Photo Products Dept., E. I. du Pont de Nemours & Co., Room 2420 Nemours Building, Wilmington 98, Del. Methods for preparing Cronaflex projection film as an offset printing plate, including the use of three new processing chemicals, are described. Copies of the bulletin are available free on request to the company.

**SAE Automotive Drafting Standard,** TR-66, printed on sheets for insertion in a standard three-ring binder, may be ordered from the Society of Automotive Engineers, 485 Lexington Ave., New York 17, N. Y. Part I includes sections on Drawing Forms, Lines and Line Work, Lettering, Tolerancing, Screw Threads, Drawing Revisions, Layout Forms, Layout Practice, Checking Practice (revised 1957). Part II includes sections on Castings, Die Castings, Metal Stampings, Forgings, Gears, Splines and Serrations, Springs, Plastics, Powder Metallurgy, Surface Finish, Chassis Frames, Body Outline and Seating Diagrams, Placement of Body Draft Views, Body Construction, Body Mechanisms, Body Silencing and Sealing Materials, Abbreviations and Symbols, and Definitions and Notes. SAE Automotive Drafting Standards are sold as a unit. Price is $8.00 to both members and nonmembers.

# *the publisher's board*

## Do we need a national society for draftsmen?

THERE is a hard core of devoted men in this country who for many years have voiced comments such as: "We need a magazine devoted strictly to the interests of the draftsman," and "We need a national society for draftsmen."

Then why has every attempt to organize draftsmen on a nation-wide scale been thwarted or unsuccessful? Why have several magazines devoted strictly to the interests of the draftsman failed?

No one knows for sure, but I've seen estimates which say that as many as a million people earn their living at the drawing board. Yet why is it this large section of our society has been unable to gain the symbols of recognition represented by a society or a medium of communications such as a magazine?

Yes, we've received thousands of comments that GRAPHIC SCIENCE fills the long-awaited need for a medium of communications for draftsmen. We've gotten pats-on-the-back from all directions. But we do not have the strength of some publications which serve machinists, or printers, or commercial fishermen. Why? Why cannot a society for draftsmen attain the strength of some engineering societies? I'm sure some very competent people have tried.

This magazine is free. Your subscription is paid for by our advertisers because you purchase the products they make. Copies go into the engineering drawing rooms of companies employing more than two-thirds of the draftsmen in industry. Why is it some of the largest manufacturers of drafting and reproduction equipment and supplies feel there is not sufficient need for communications in this field to warrant their supporting it?

This same problem comes up in the organization of a society of draftsmen. To be successful, an organization must have the blessing and support of both top management and suppliers. Often when draftsmen form groups, the cry "unionism" comes up from management. So, to date such organizations have received very little encouragement.

From my experience, I've found engineering drawing personnel to be hard working, ambitious, and intelligent. There should, logically, be an instrument such as a society to help them attain their goals.

There are a number of local and regional groups, but none have yet attained a high national status. Some of these groups are doing very commendable work. In fact, GRAPHIC SCIENCE has been approached by several of these groups and asked to be the voice for promoting the group or the instrument for organizing the local and regional groups into a national society.

We are *not* interested in organizing or running a society, but we are quite concerned with serving our field to the best of our ability. Possibly, we could serve as a clearing house for ideas which would lead to a successful approach to the problem.

Please send us your comments. Address suggestions to: Charles E. Rhine, Publisher, GRAPHIC SCIENCE, Wilton Center, Wilton, Conn.

# *Advertising Index*

## MASTER MULTIPLIER

*one thing in mind*
*and very specific*
*a very strong urge*
*to be very prolific*

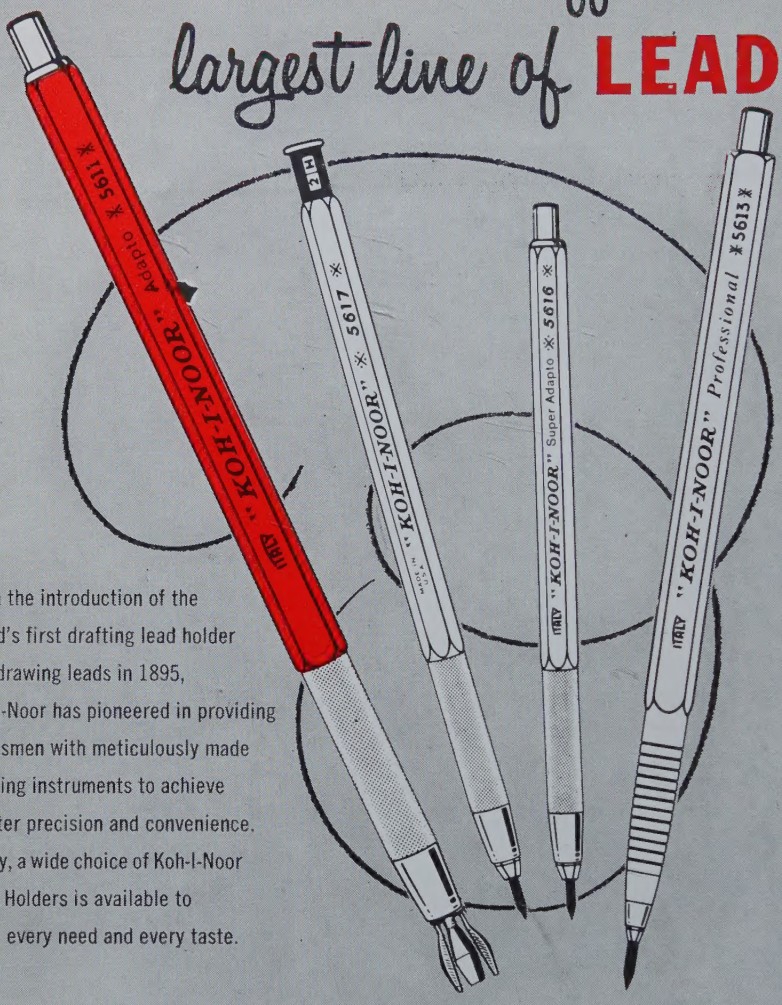
In our humble opinion, Brer Rabbit's reputation as a multiplier is vastly overblown. Compared to Printmaster 900 he's strictly single-track. Brother Rabbit can reproduce only himself. Printmaster 900 will process any dry diazo material up to 42" wide. In one pass. Without sticking. And at speeds up to 75 feet per minute. More: "900" offers a major advance in whiteprinting—new, sleeveless, scratch-proof developing, exclusive with Ozalid. No slip sheets. No sealing sleeve. Further, no costly electron tubes. And no—comptrollers please note—no heavy investment. All Ozalid Whiteprinters can be bought, leased or rented without tying up capital. Like the full, dollar-saving story on "900"? Write today. Ozalid, Dept. 341, Johnson City, N. Y.


**Printmaster 900.** *Big reproducer at top speed.* Heavy duty, dry-developing whiteprinter. Ht: 70½"; Width: 84¼"; Depth: 46½". Simple, dependable, economical.

**Remember:** for best results from Ozalid Whiteprinters use Ozalid Paper and Ozalid Supplies...we repeat; use Ozalid Paper and Ozalid Supplies.

OZALID
WE REPEAT
OZALID
DIVISION OF GENERAL ANILINE & FILM CORPORATION

# KOH-I-NOOR offers the world's largest line of LEAD HOLDERS




From the introduction of the world's first drafting lead holder and drawing leads in 1895, Koh-I-Noor has pioneered in providing draftsmen with meticulously made drawing instruments to achieve greater precision and convenience. Today, a wide choice of Koh-I-Noor Lead Holders is available to meet every need and every taste.

**No. 5611**—All metal, balanced, lightweight, with knurled finger grip. Patented "Adapto-Clutch" holds complete range of lead diameters. Replaceable clutch is non-turn, non-slip. "Color-Coded" push button identifies lead degrees.

**No. 5617**—Non-slip, non-turn "Adapto-Clutch" takes all diameters in 17 degrees of lead. Push button control has built-in degree indicator. Perfectly balanced, with knurled finger grip.

**No. 5616**—Same as No. 5617 above, but without built-in degree indicator.

**No. 5613**—New, lightweight, low priced, quality holder, perfectly balanced, with non-slip, non-turn replaceable clutch.

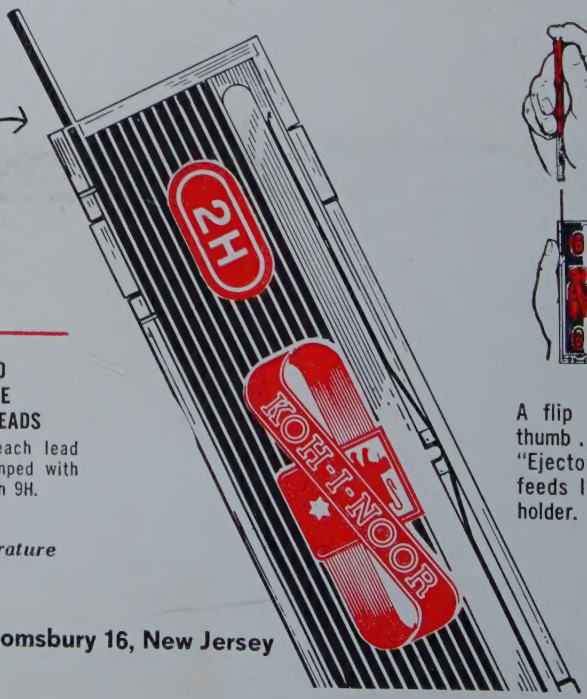
## and DRAWING LEADS...

**No. 2200-M**
**KOH-I-LAR**
**PLASTIC LEADS**
Six degrees (6H, 4H, 2H, HB, B, 3B) for use on DRAFTING FILM, in Ejectomatic Dispenser.

**No. 2200-I**
**NEW EJECTOMATIC**
**LEAD DISPENSER**
A flip of the thumb feeds lead from this compact plastic dispenser to the holder, cleanly without need to touch lead. Available in 17 degrees of graphite and 9 colors.

**No. 2200-D**
**DUETTE**
Handy plastic slide-top box contains 2 sharpened and imprinted leads of a degree. Available in all 17 degrees.

**No. 2200**
**GRAPHITE**
**DRAWING LEADS**
Six to a box, each lead pointed and stamped with degree. 6B through 9H.






A flip of the thumb . . . and "Ejectomatic" feeds lead to holder.

*Write for Descriptive Literature*

**KOH-I-NOOR Inc., Bloomsbury 16, New Jersey**